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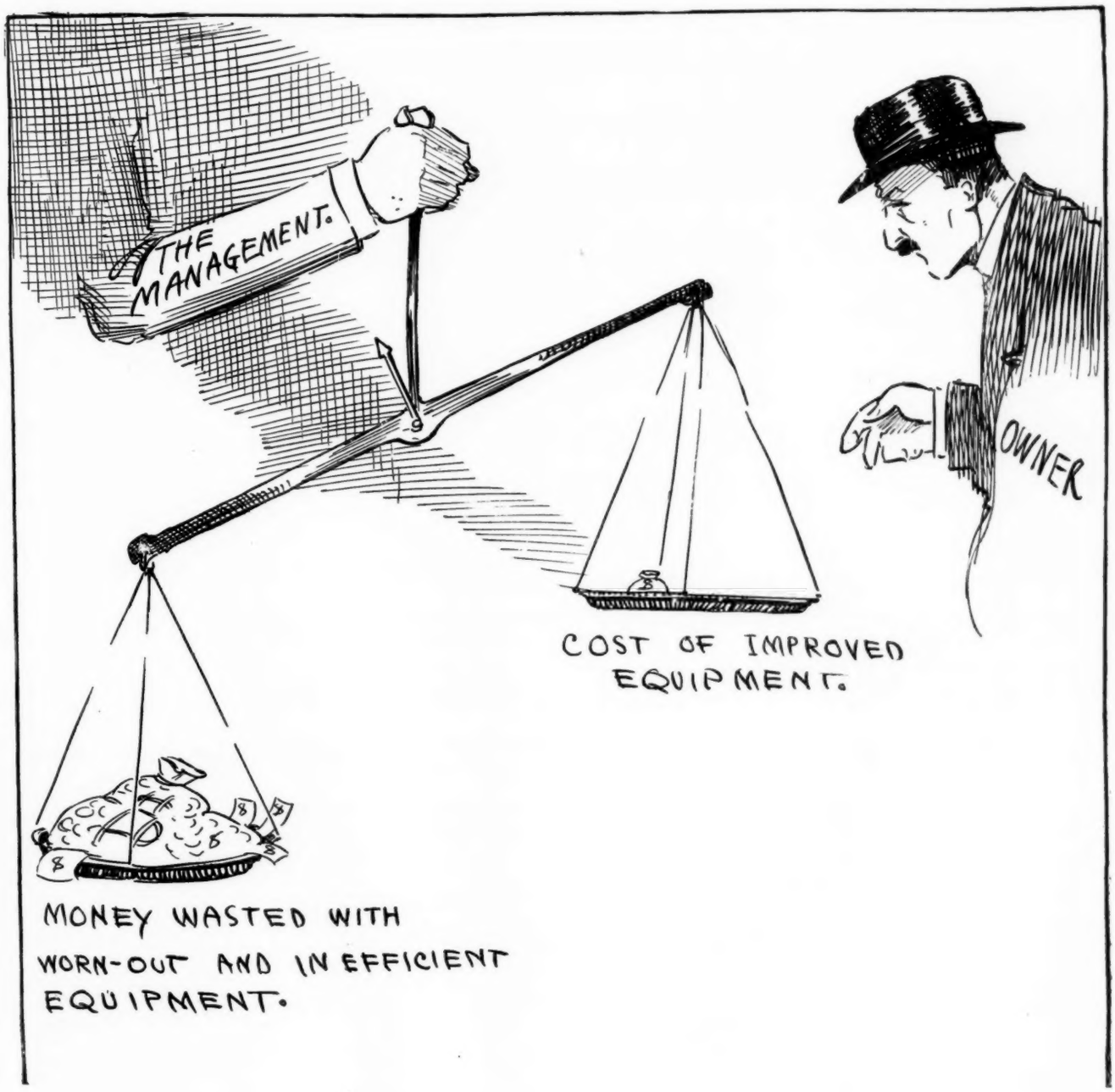


HOW TO MAKE THE OWNER SEE IT

Repairs to a Large Chimney

By Charles H. Bromley

SYNOPSIS—The methods and material used to repair a brick chimney 350 ft. high and having a 28-ft. 6-in. base. Changes are made in the arrangement of the lightning conductors. From a stationary scaffold at the top of the chimney, painters' scaffolds will be hung, and all work done from them. Cotton rope is used. The repairs will cost about $10,000. The protective measures against liability for injury and death as adopted by the owners are explained. Twenty-four years ago a "jack" required two weeks to reach the top; this time the jack gets up in 15 hours.

Preparing to Inspect the Chimney

A chimney 350 ft. high, 28 ft. 6 in. wide at the base and serving the boilers for the Clark Thread Co., manufacturer O N T spool cotton, East Newark, N. J., employing over 4000 hands, is an important part of the power plant. By means of a powerful glass, the upper part of the chimney may be closely viewed from the ground or roofs of the mills. Its condition is thus watched until the perceptible cracks, openings between the joints of the brickwork and the corrosion and disarrangement of the top plate and conductors warrant engaging a steeplejack to ascend the chimney and make a close-range inspection.

Reaches Top in Fifteen Hours

Twenty-four years ago this chimney was "pointed up" and repaired generally. The "jack" at that time required two weeks to build himself to the top (there is no permanent ladder), but John Cook, the man now doing the work, reached it in 15 hr. His methods, therefore, are interesting. Figs. 1 to 4 show the chimney, the steeplejack and a part of the brickwork pointed up some years ago with special cement.

To hold the ladders and pulley blocks, a "dog," Fig. 5, is driven into the brickwork, the rope hitches being so made as to be engaged by the projections. The dog has a chisel point. It may surprise many to know that most of the dogs holding the ladders are not driven in the chimney more than 2 in.

Mr. Cook uses ⅝-in. cotton rope of good quality wherever rope is required. Wooden ladders 12 ft. long, having 11 ft. effective length, after allowing for joining, are used for the straight run, while 24-ft. ladders were provided for getting out and over the "bell" of the chimney.

Method of Attaching Ladders

The method of putting up the ladders is interesting. Assume that the first and second ladders are in place at the base of the stack. Going to the top of the second ladder, the jack gets his legs around the ladder, as shown at the top of Fig. 1, and drives a dog into the chimney as high as he can reach. A 3-lb. machinist's hammer is used. A block-and-fall is attached to this dog and another ladder is hoisted by the helpers below. The sling is fastened below the center of gravity of the ladder so that the jack can tip it down to a vertical position preparatory to lowering it into the rung projection of the ladder below. The ladder is then tied to the newly driven dog and another is driven near the top of the topmost ladder, that ladder being then tied to the dog. This process is used throughout, with slight modifications where the 24-ft. ladders swing out over the bell.

Having reached the top, provision is made for fastening blocks-and-falls on which to hang two bos'n's chairs, one on each side of the chimney. These secured, the jack is pulled up by his assistants and the stack is inspected, each chair being pulled around to enable the workman to inspect the entire surface.

How the Contract Is Made

In the case of the Clark company the jack contracted to make an inspection and to report on the condition of the chimney. This constitutes a separate job. All the repair work will be done in this manner—i.e., the jack will receive a certain sum for pointing up the brickwork, another sum for repairing the lightning conductors, and so much for repairing the top plates, which have a total weight of six tons.

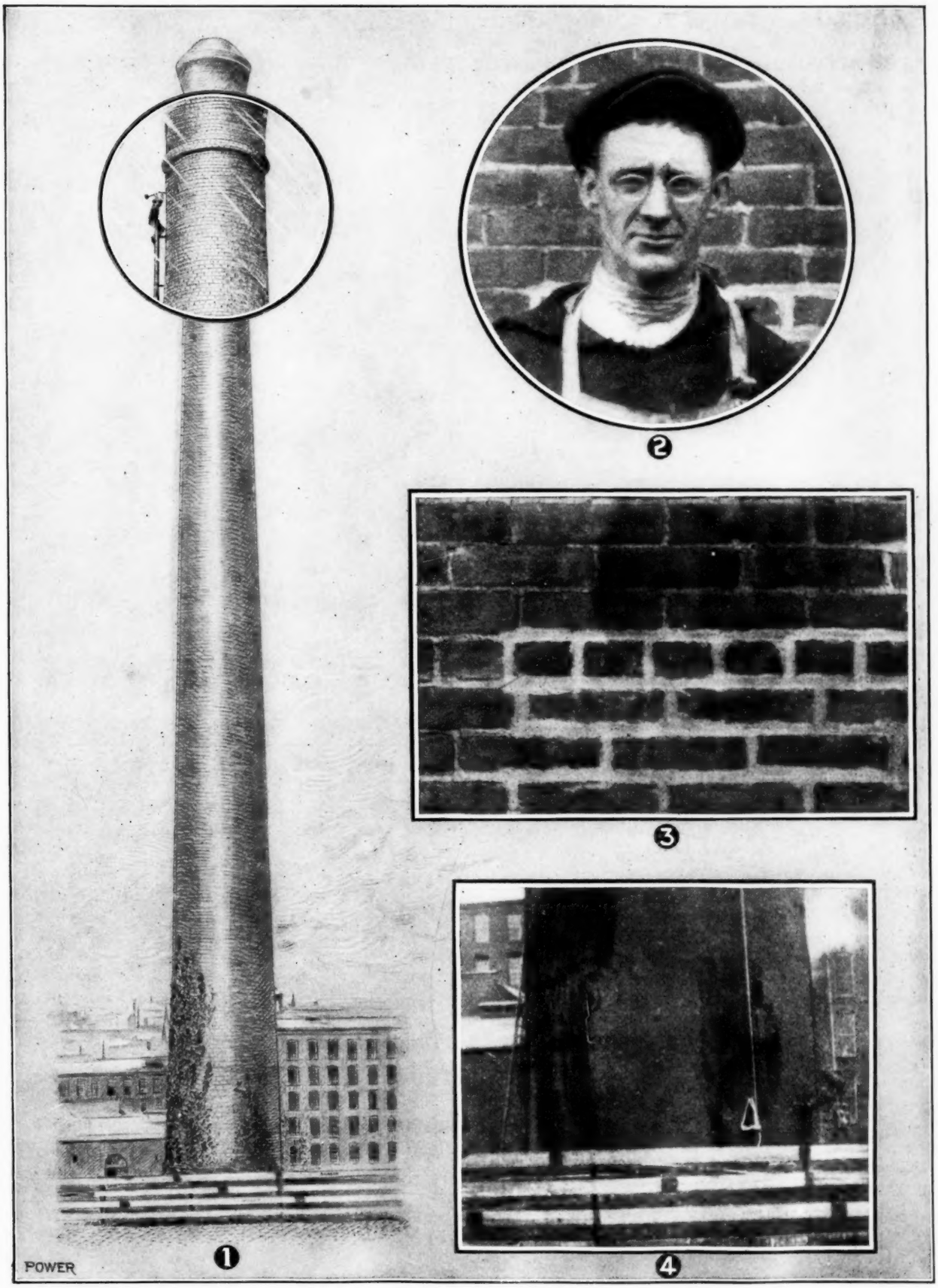
Protection against Liability for Accident

On account of the workman's compensation and employers' liability laws as they exist in many states, it is now general practice, where possible, to fence off a plot around the chimney, this inclosure being the jack's outright. "No Admittance" and "Danger" signs are conspicuous. If a company employee goes inside and is injured or killed, the company is not responsible; neither is it in anyway liable for injury or death to the jack or his men; the former is heavily insured, a special policy being carried. Figs. 1 and 4 show the inclosure; notice the jack in the chair in Fig. 4 ready to be hoisted. One gets a good conception of the size of the chimney base from this picture and, from Figs. 1 and 8 is able to appreciate its height.

A few years ago the chimney was struck by lightning, and this, perhaps, accounts for two cracks, one about 10 ft. long, near the top, and another approximately 40 ft. long, about 40 ft. below the top crack. At places along the large crack a strong odor of gas proves that the crack is through the brickwork. The cracks will be filled in, and the larger one, in addition to filling, will have two or three heavy gunmetal bands fitted to reinforce the chimney at that point.

Repairs to the Lightning Conductor

The present lightning conductor consists of a 2⅜x¼-in. copper band bolted to the top of the iron plates on the bell. Connected to this band are four 1¼-in. copper "points," spaced equidistantly and rising vertically for 20 in. Another 2⅜x¼-in. band is fastened below the bell, as in Fig. 6. To these two bands are bolted $\frac{5}{32}$x3⅛-in. copper strips, the latter, on the north and south sides, running to the ground, where the coils shown are placed in a bed of gas retort carbon about 2¾ ft. below the surface. Spaced 11 ft. 4 in. apart are ½-in. round copper points which project 4 in. at right angles to the length of the chimney. The copper strips are looped to a 1½-in. radius, the loops being spaced 11 ft. 4 in. apart, a point

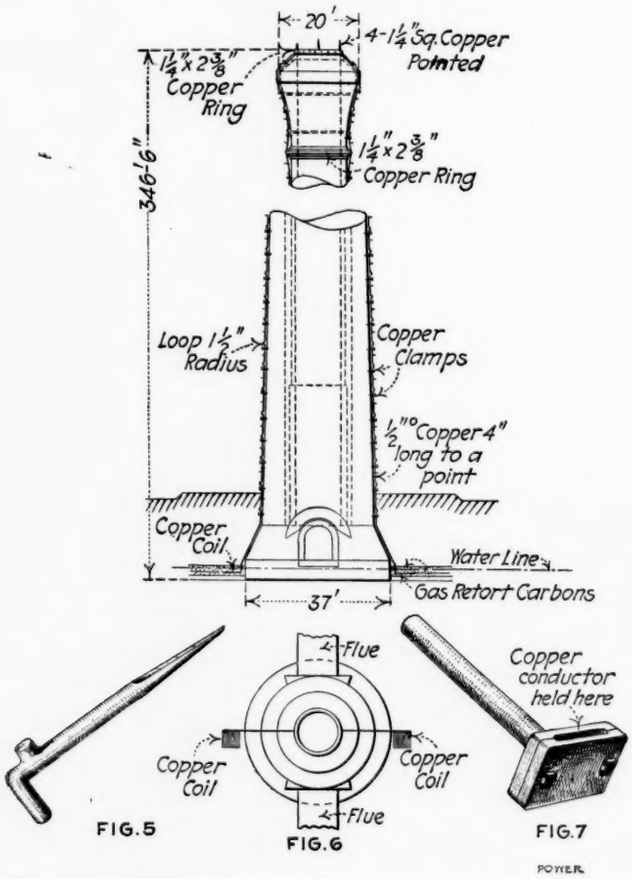


VIEWS OF THE CHIMNEY AND THE STEEPLEJACK

Fig. 1. Putting up the ladders as seen through a telescope. Fig. 2. John Cook, steeplejack. Fig. 3. Wall pointed with high-grade cement. Fig. 4. At the base of the chimney.

being placed between each loop. The clamps used to hold the strips are merely pieces of 2⅜x¼-in. copper, long enough to cover the strip and leave room for nailing it to the brickwork. All these features are shown in Fig. 6.

Changes are to be made in the arrangement of the con-



DETAILS USED IN STACK REPAIR

Fig. 5. "Dog" used by the steeplejack. Fig. 6. Showing arrangement of lightning conductor. Fig. 7. Clamp for copper conductor strips.

ductor. Instead of a ring at the very top, one will be placed about 6 ft. below, and another in the place now occupied by the present lower one. Points a little over 6 ft. long will be placed vertically on the top ring, and braced from the top plate. A more substantial clamp, such as shown in Fig. 7, will be used. To set the new clamps, the chimney will be drilled to admit the shank its entire length; broken brick will be driven in around it and thin grouting poured in.

From the ground to a height of about 80 ft., the conductor is as sound as when put on 24 years ago, but it is corroded away perceptibly above it. Viewed from the ground, the lower part is black, and then as the corroded part is reached it appears bright, having a whitish-green color where most corroded.

THE STATIONARY AND MOVABLE SCAFFOLDS

Preparatory to pointing the brickwork, a stationary scaffold is built at the top of the chimney immediately under the bell. It is simple, consisting mainly of 4x6-in. planking, 24 ft. long. There are four of these planks, joined and situated as in Fig. 8. After the brickwork above the floor is pointed, two painter's scaffolds will be

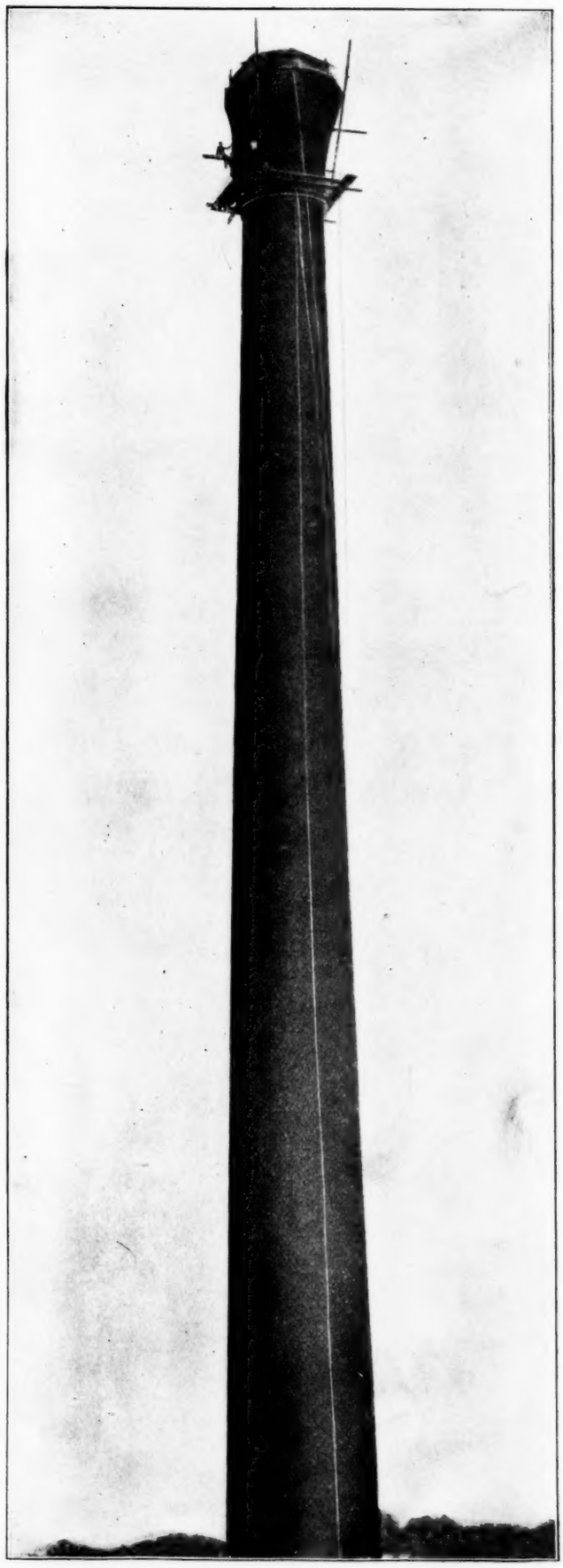


FIG. 8. SHOWING THE STATIONARY SCAFFOLD

hung from the stationary one, and from these all work below will be done.

The approximate cost of all repairs is $10,000.

Composition of Cement for Pointing

The cement used for pointing is most durable; Fig. 3 shows a wall partly pointed over three years ago. The cement is very hard, and when a knife is used to chip it off to test it, the brick will break off with the cement. The jack stated that this cement will outlast any other made. Although the old cement in this wall was put on years before the new, and should therefore show signs of deterioration, it will be noticed that there is a big difference in quality in favor of the new.

This cement is made as follows: 47 per cent. burned white sand (passed through very fine mesh screen), 46 per cent. whiting, 5 per cent. red lead and 2 per cent. litharge. It must be well mixed while dry, and turned four or five times. Enough boiled linseed oil is used to give it a not too thick consistency. A charge of $1.50 per square yard is made for pointing with this cement.

The repairs are being done by John Cook, South Orange Ave., Newark, N. J., who takes pride in relating that he has worked on most of the highest chimneys, spires and bridges in the world, and will continue until—well, until he drops. He will do this some day, for, he says, "They all do."

Compressed Air in Mill Work

The variety of uses to which compressed air may be profitably put in a manufacturing plant is exemplified at the mills of the Burgess Sulphite Fibre Co., Berlin, N. H. The principal output is sulphite fiber pulp.

As the plant is built on rocky ground, each addition or extension to the building, and each alteration, such as changes in piping location, means removing rock or cutting holes in concrete walls or floors. For this work about 15 compressed-air, hand-hammer drills are necessary. Air is also employed in boring holes in wood and metal, about 20 small pneumatic boring tools being kept on hand for these jobs, and used also for rolling boiler tubes, etc.

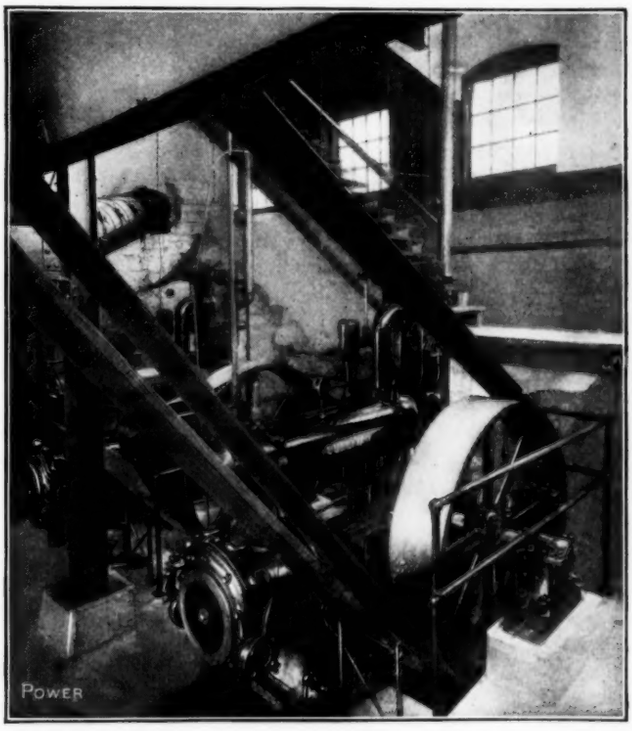
There are 18 digesters, each about 15 ft. in diameter and 50 ft. high. The shells are made of very heavy steel plates to withstand the steam pressure of 80 lb. To protect the plates from the action of the sulphuric-acid fumes, the interior is lined with a special firebrick, the joints being laid in a special acid-resisting cement. When defects are found in this lining, as happens occasionally, they must be repaired immediately so that no acids may penetrate through to the exterior steel plating. In making these repairs, pneumatic chipping hammers are used to cut out the brick.

The gate valves, 10 in. in diameter, at the bottom of the digesters were formerly opened by hand, a somewhat laborious process with 80 lb. pressure behind them. They are now opened by rotary air motors, connected to pulleys mounted on shafts, which in turn are geared to the valve stems. These motors are reversible, so that the valves may be opened or closed. There are air whistles at a number of points in the plant for signaling purposes, etc.

The finished pulp is conveyed from one point to another by wood-stave pipes made of narrow strips of wood of the desired diameter, and held in shape by ¾-in. hoops of round iron placed at frequent intervals. The hoops are formed at the plant by a set of bending rolls operated by a pneumatic rotary drilling tool. The hoops can be bent up in a few minutes to meet all the requirements for some time, and the rotary drill is then available for other use.

Air hoists are also placed at various points in the mill for raising the covers from the digester tanks or for similar work.

Another incidental use of air consists in rethreading the numerous odds and ends of bolts that accumulate about a plant of this sort, a rethreading machine, driven by a rotary air tool, having been arranged recently to recut or clean the bolt threads.



Motor-Driven Angle-Compound Air Compressor

Air Compressors

Compressed air for the various tools and operations is supplied by two Sullivan angle-compound compressors, with low-pressure cylinders 16 in. and high-pressure cylinders 9¾ in. in diameter; the stroke is 12 in.

These machines, shown in the illustration, are driven by a belt from individual 115-hp. motors mounted above them. Each compressor supplies 628 cu.ft. of free air at 225 r.p.m. Ordinarily, but one machine is operated, the second being held in reserve.

This new type of air compressor (described in the Dec. 9, 1913, issue of Power) was selected on account of its

large displacement capacity as compared with the small floor area required. As the engine room had to be excavated out of the solid rock, it was important, for construction reasons alone, that the air plant should occupy as little room as possible. The overhead drive was another device adopted to economize floor space. These machines have been installed for nearly a year and have given satisfactory service.

Will Quizz, Jr.

SYNOPSIS—Will Quizz, Jr., has difficulty in identifying the return water in the pipe as merely a liquid piston in a long cylinder against which the steam acts. Chief Teller endeavors to make the matter clear.

"Chief Teller, I may be like the fellow who understood all about an automobile except how it could go without a horse hitched to it, but I don't quite see how the indirect coils in the sub-basement keep clear of water when some of them at the far end of the building are only a foot above the floor. The trap is on the floor, but the basement floor is 8 ft. below that of the power house, and the top of the open tank again is at least 6 ft. above the floor, making 14 ft. elevation in all. How does the water get back without a pump to push or pull?"

"The coils do keep clear of water when you keep 5 lb. steam pressure on the building, don't they, Will?"

"Yes, chief, and that's what I can't see through."

"Suppose we use a glass U-tube about half filled with water to demonstrate. If all pipes were made of transparent glass, we could then easily catch onto some things hard to understand in dealing with steam, air and water

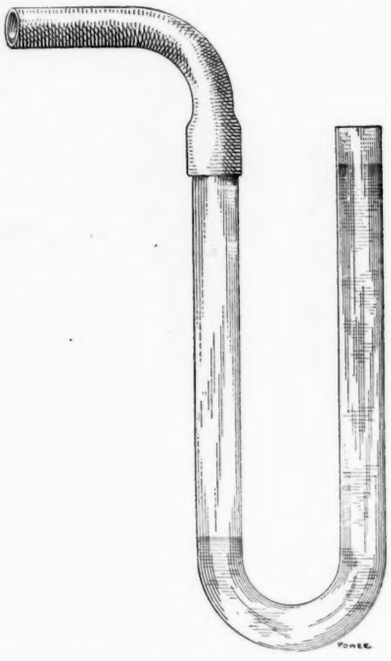


FIG. 1. A U-TUBE

in heating systems. Here we are (Fig. 1). I keep this bent-glass tube for just this purpose, and by keeping in mind its lessons the whole matter becomes easier to reason out

"Now, see how the water acts when you exert even a slight pressure of air on one leg of the tube. If you introduce more water into the air space it will overflow at the other side, but the difference in level will remain the same as long as the air pressure remains constant. The steam pressure acts in just the same way in the heating system. There would be no danger of the radiators flooding with pressure on. A pressure of steam on one side will force the water down in that side and up in the

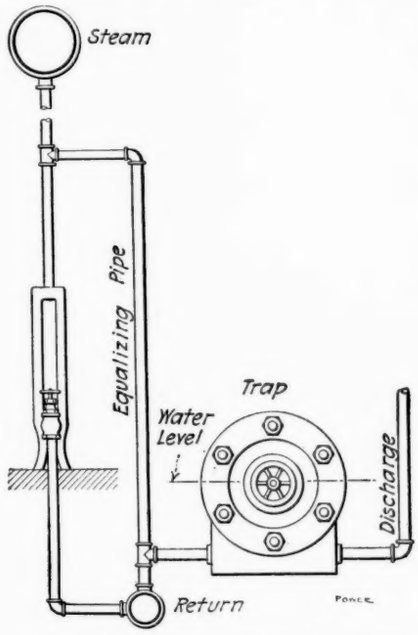


FIG. 2. TRAP ABOVE THE RETURN

other. The difference in the levels will be a column of water, the weight of which is equal to the pressure exerted by the steam. If the water is cold, approximately 60 deg. F., the height for a 5-lb. pressure will be about 11.5 ft.

"The rule is to multiply the pressure by 2.3 to get the equivalent in feet elevation, or, each foot in height is equal to 0.434 lb. (a little less than one-half pound) pressure. These two constants are mighty handy to remember, Will.

"As the water we are dealing with is hot, it is not so heavy per foot of elevation. Besides, the small amount of steam present incidental to the release of pressure helps to lighten the column and to increase its velocity, so that with a 5-lb. pressure, we have an active return and the radiators clear of water.

"You will notice that in this diagram (Fig. 2), the trap is about 18 in. above the return in the basement, which is on the same level as the power house. This is all right although it seems contrary to the rules.

"When this trap was first installed the steam fitter had not connected the equalizing pipe and the basement sounded like a boiler shop, the pipes hammered so. The reason was that the return lines had steam and water

flowing through them at the same time. The slugs of water traveling at a rapid rate and coming in contact with one another and the short-turn fittings caused water-hammer. In other words, it was neither a wet nor a dry return. As you will see, the trap is connected on what is equivalent to the discharge side of the U-tube, so that all the water would be driven out of the system when the trap was in the discharging or open position, and when in the other or close position the lines would have to fill with water again before the trap would discharge. The whole operation would be noisy. The equalizing connection is made from the steam header, or its equiva-

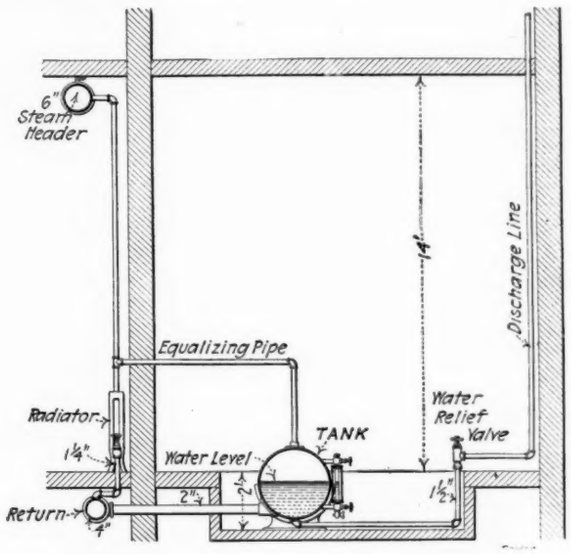


FIG. 3. A SPRING-LOADED VALVE AND NO TRAP

lent, to the inlet side of the trap, so that the water level is maintained at the level of the trap.

"Now, if you put an adjustable, spring-loaded valve (it is commonly called a water-relief valve) in the equalizing pipe line the level of the water can be regulated by it to any point below the trap level.

"Keeping the U-tube in mind, consider a trap as connected on its discharge side. With sufficient pressure, the water will be expelled downward and entirely out of the one side and up the other to the trap. But this is not a desirable condition for a heating system, because, as before stated, the water and the steam would mingle and cause water-hammer. The equalizing pipe is virtually a bypass connection between the two sides of the U-tube at some point above the bottom. It is obvious, then, that the bottom of the U-tube (or its equivalent, the return line) cannot be emptied by air or steam pressure, while the bypass remains open or unobstructed. The result is that by the use of resistance the water will be driven down until it reaches the desired level and not below it. The amount of resistance used will determine the relative level on the two sides.

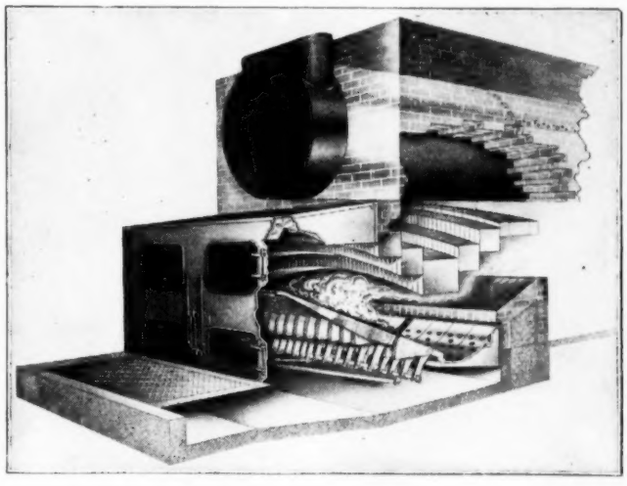
"Suppose, then, that it was not convenient to locate the trap just at the level it is desired to have the fixed water line, it can be located above that point by putting a spring-loaded valve in the equalizing or bypass pipe. In other words, for any desired difference in level the resistance of the valve must equal the amount of the unbalanced weight of the two columns of water.

I have used a spring-loaded valve alone, without a trap. Fig. 3 shows the conditions in that case. The steam pressure was constant and the discharge at the ceiling of the basement had a height of 14 ft. By simply adjusting the tension on the water-relief valve, the water level was established and maintained at any point desired in the down side (of the U-tube), as shown by the gage-glass. This level did not vary more than 1 in. in operation."

National Smokeless Stoker Grate

The furnace shown has been designed to burn, efficiently and without smoke, any kind of low-grade nut or slack coal. It is equipped with an inclined grate having two fuel pushers operated by the levers shown and an ash-dumping plate at the rear; it may also be operated from the front of the furnace. To secure smokeless combustion, a quantity of coal is stored directly inside of the firing-door, where the heat reflected from the arch drives off the volatile gases. Air entering through small holes in the firing-door combines with the gases, and the mixture is burned as it passes over the incandescent fuel at the rear of the grate, which receives its air supply from the ashpit.

Each shifter is made up of a series of sector-shaped elements attached to connecting links which are pivoted to a rod running crosswise with the furnace. Normally, the elements are flush with the grate, but by means of the operating levers they may be raised through spaces in the grate to push the coal toward the rear. The arc at



SHOWING STOKER AND FURNACE

the larger end makes it possible for the sectors, in any position, to fill the openings and prevent fine coal falling through to the ashpit. The dump plate is pivoted back of the center to give a large opening for clinkers, and the rear part of the plate is curved upward, so that when the ashes are dumped it will project over the opening and tend to push the clinker down to the ashpit.

When the incandescent coal on the lower shifter has been nearly consumed, it is dumped onto the ash plate at the back, and the elements of the shaker are brought back

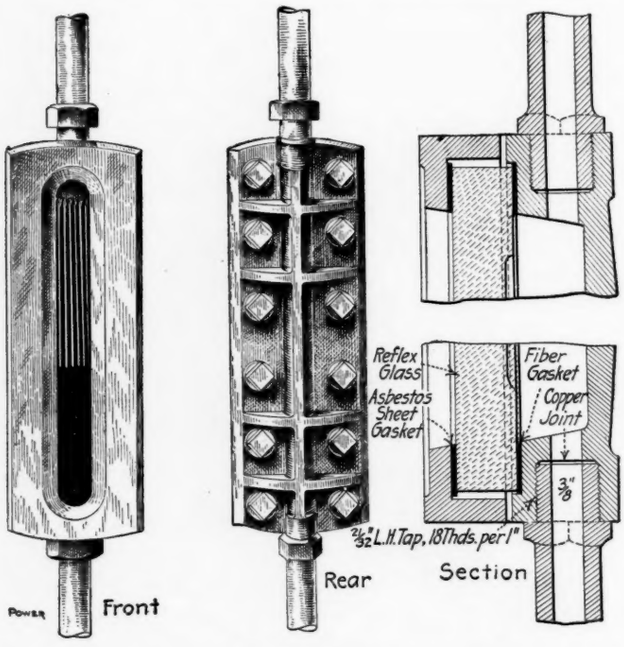
to their normal position to receive the coked coal pushed back by the front shifter. The fresh coal then moves onto the front shifter, where the coking action is completed. It is possible to insert a large charge of coal at each firing so that the door is opened only at long intervals and conditions are right for smokeless and efficient burning and reduced labor by the fireman. By reason of the correctly designed combustion arch and the manner in which the coal is progressively fed down the grate, automatic stoker conditions and economies can be duplicated with this furnace at a cost slightly in excess of that of a stationary grate installation.

The furnace is designed and manufactured by the New Albany Manufacturing Co., New Albany, Ind.

Standard "Okadee" Reflex Water Gage

In line with the slogan "Safety First," the Engineers Specialties Co., 333 South Dearborn St., Chicago, is putting out a water gage with a flat glass about ¾ in. thick for stationary and marine work. The gage has been in use in the locomotive field for a number of years.

As indicated in the drawings, the glass is clamped between two naval bronze castings, with a passage for water



FRONT, REAR AND SECTIONAL VIEW OF WATER GLASS

and steam at the rear. On the water or rear side the glass is corrugated so that there is no reflection of light, and the water getting into the grooves appears jet black. Above the water line the glass has a white metallic appearance so that the contrast is decided, thus the water level may be seen easily from any point in front of the gage. The glass is thick enough to withstand any pressure used in boilers. There is no breakage and flying of glass as with the ordinary round tube. On rare occasions the glass has been known to become friable in spots and a small pinhole leak will develop. In such a defect there is no particular danger to the fireman, however, and the remedy is a new glass.

Brown Electric Indicating Pyrometer

Severe losses can occur in boiler operation from an excessive temperature in the stack, and the loss of valuable heat units which should be utilized under the boiler. Considerable data on boiler operation can be procured from measurements of the temperature in the furnace. Tests will show whether an excessive percentage of the heat is passing up the chimney; give the relative results secured from each boiler; and show if the fireman cleans the fires at the proper time and the flues are kept clean.

FIG. 1. BOILER ROOM INDICATING PYROMETER

These temperatures can be readily noted by the use of the electric pyrometer, made by the Brown Instrument Co., Philadelphia, Penn., to indicate the temperature in either the first, second, third or fourth pass of a boiler; or at all these points if desired, and also, if convenient, at the top of the furnace.

One type of equipment is the indicating pyrometer, with a switchboard near the boilers, by means of which the fireman can switch onto the one indicating instrument. Thermocouples are placed in the various passes or in the firebox, and the temperature noted.

At the same time the chief engineer should have a recording pyrometer in the office to keep a day-and-night temperature record on a chart, of either one or all of the boilers which are carrying a load.

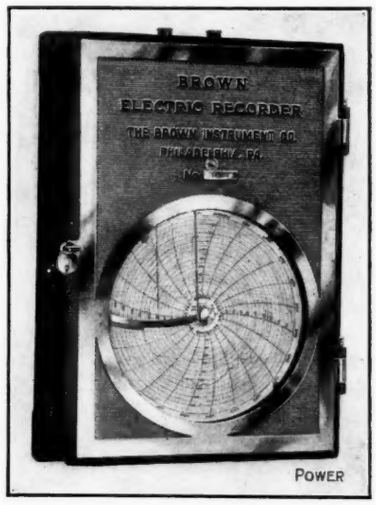


FIG. 2. OFFICE RECORDING INSTRUMENT

Fig. 1 illustrates the standard form of the electric pyrometer, with a switchboard for the fireman to switch the instrument on to any boiler. Fig. 2 shows the recording pyrometer for the chief engineer's office.

Operators vs. Output—Contrary to what one might assume, a 20,000 or 25,000-kw. turbine generating unit does not require additional operators over a 12,000-kw. unit in proportion to the increase in output. The output, per man required for operating, increases from 40 to 50 per cent.

A Temporary Balancer Set

By C. V. Hull

The power system of a large manufacturing plant was changed from 110-volt generators on a three-wire circuit to 220-volt generators with balancer sets on the same circuit. Soon after the change, trouble with the commutators of the balancer set made several days' repair work necessary. It had been planned to have two balancer sets, but the second had not arrived and repairs had to be made and the power kept on. In order to prevent any shutdown, the electrical department arranged a temporary balancer set.

This work was handicapped because there were not two similar motors in stock, but two 110-volt motors were selected and fitted with pulleys of proper sizes to allow each to run at its rated speed. These motors were anchored in line and belted up.

The field current of each was carefully determined. Then the two fields were connected in series across the 220 lines. But to give the field requiring the greater current full strength, two small rheostats, R and R_1 were connected in parallel with the field of the motor which required the least current. This gave full field to both motors since the rheostats were adjusted to care for the difference between the two fields.

The armatures were connected in series across the 220-volt mains, and the current in starting passed through the rheostat S. After starting, the terminal posts were short-circuited by the single-pole, single-throw switch C, from which the current flowed through the armatures in series, then to the main through switch D.

The neutral wire was connected to the armature circuit by a big, old-fashioned single-pole switch E, which was used because it was the only one large enough in stock.

Two small single-pole switches, A and A_1 were provided in the field circuit in case it seemed advisable to make any changes in the wiring or the rheostats mentioned. A permanent opening was also made in the field circuit in case repairs or changes were needed, since it was not certain that the outfit would do even temporary service.

No ammeters were installed as it was not thought necessary to know the amount of unbalanced load. Voltmeters were connected as usual and indicated practically the same voltage, showing the load to be fairly well balanced.

The starting directions for the men, who were engine operators and knew little of electrical work, were as follows:

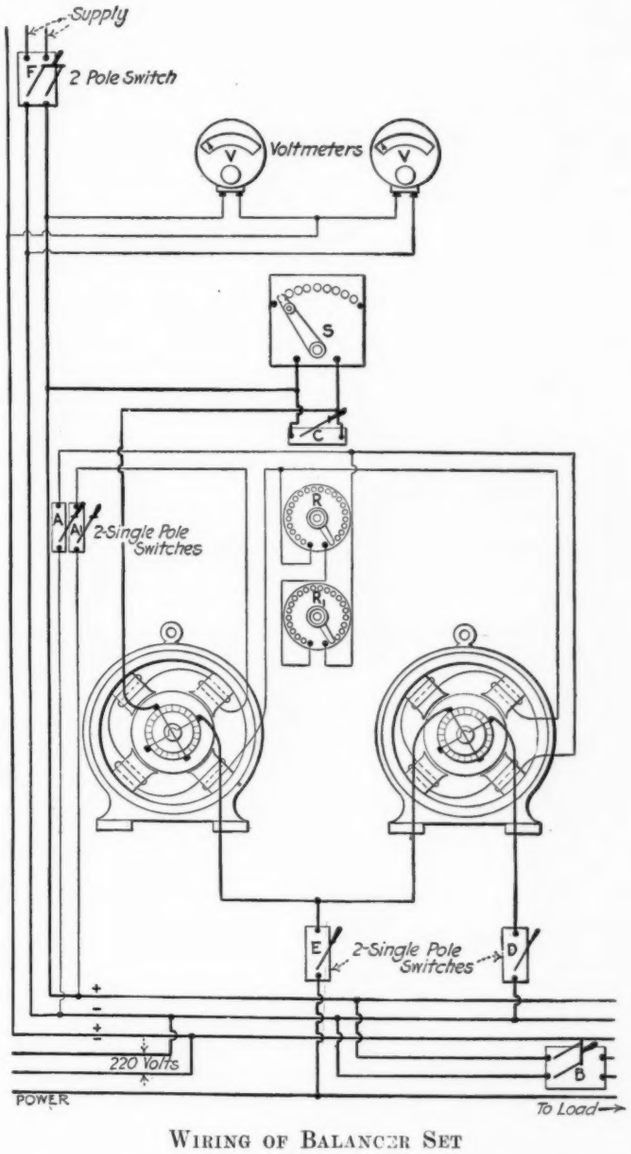
To start the balancer set:
See that switches A and A_1 are closed.
Close switch F.
Move lever of rheostat S slowly to running position.
Close main feeder switch B.
Close switch C.
Close switch E.
Close switch D.

To stop the balancer set:
See that main line switch B is open.
Open switch F.
Open switch D.
Open switch C.
Open switch E.

CAUTION—Be sure that the main line switch B is open until the balancer set is started and before stopping the balancer set. Do not pull any switch on the balancer board before B is pulled.

It will be seen from the directions that the balancer was started as two 110-volt motors in series on a 220-volt circuit. Then the neutral was cut in before the load switch was closed.

This temporary set did excellent service for some time. Of course, there were times when the voltage regulation was not all that could be desired, but the belt always stayed on even when the load was considerably unbalanced. The power service was always good, although the lights on the heavy side were sometimes dim for a few moments.



Wiring of Balancer Set

Despite the crudeness of the arrangement, the men had no real trouble with it. No one attempted to start the set without closing the field switches A and A_1. Once the main switch was closed before the set was started, which caused the breaking of a number of incandescent lamps. The outfit was so satisfactory that it was kept as an emergency outfit until a second set was installed for permanent use, as 24-hr. service made two sets necessary.

New Method of Detecting Cracks in Boiler Seams

S. F. Jeter, Hartford, Conn., has lately patented a means for detecting cracks at the seams of boiler shells before the cracks have become dangerous. The plan is to form one or more small pockets or slots in the plate or plates adjacent to the points where cracks are likely to occur. These slots are small enough not to appreciably decrease the strength of the plates. When the crack starts it continues until it opens into the slot in the plate, and then leakage of steam or water will occur to give warning of the presence of the crack before it extends completely through, or to the edge of the plate. Of course, the slots are not cut clear through the plate; they consist of a recess in the plate, making it thinner over the place where a crack may develop. The length of the slot must be run transversely of the riveted joint.

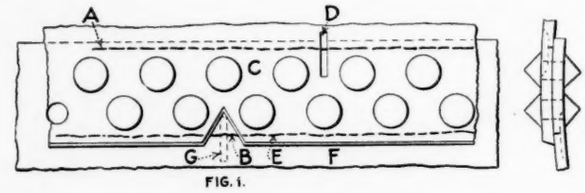


FIG. 1.

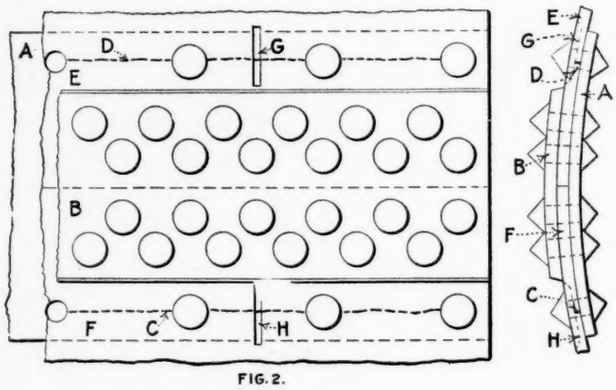


FIG. 2.

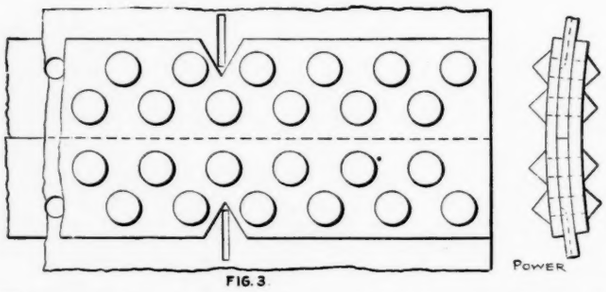


FIG. 3

WHERE SLOTS ARE LOCATED FOR DIFFERENT KINDS OF JOINTS

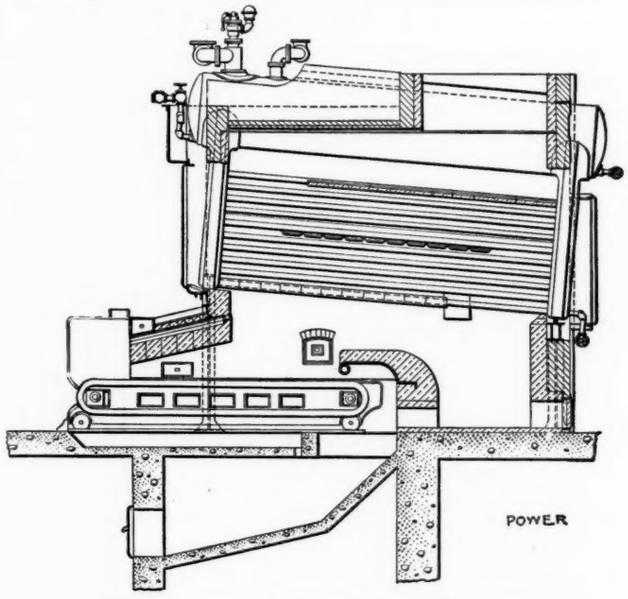
In Fig. 1 is shown a lap joint with the places where cracks usually occur, *A* and *B*. Sometimes a crack *A* will start on the inner surface of plate *C* over the edge of the plate beneath and gradually work to the outer edge of plate *C*. Ordinarily, this crack cannot be seen until it has reached the outer edge of plate *C*, when a dangerous condition will have been reached. By slotting the plate *C*, as at *D*, and decreasing its thickness, the plate will crack through at this point and give warning that this seam needs attention. The same is true for a crack as at *E* in the plate *F*. A slot *G* is made on the inside of the plate *F*, and to promote observation of it a piece is cut out of plate *C* over the slot in *F*.

With a butt strap joint, Fig. 2, where the inside strap *A* is larger than the outside strap *B*, cracks *C* and *D* occasionally occur. Usually they cannot be detected until dangerous, because they are inside the edges of plate *A* and must come all the way through the plates before being detected from the outside of the shell. By slotting the plates *E* and *F*, as at *G* and *H*, steam will blow through, giving warning of the approach of a dangerous condition of the joint.

When the straps are the same width as in Fig. 3, sections of the outside strap may be cut away over the slots in the butting plates.

Boilers with Divided Baffling

The illustration shows a section through one of three Heine water-tube boilers, of 540 hp. each, at the Lytton Bldg., Chicago. They are equipped with McKenzie chain-grate stokers, with a divided-pass method of baffling, as shown. Each boiler is built for 200 lb. working pressure, with two large shells, of three sheets, ½ in. in thickness. The longitudinal seams are of the triple-riveted, double-strap, butt-joint type, and the round-about seams with lapped joints, single riveted. The water legs are built of two sheets, machine flanged and joined by a butt strap along the bottom and sides; the legs are stayed with twice the customary number of hollow stay-bolts. Each boiler has three hundred and forty-nine 3½-in. by 16-ft. seamless tubes, No. 9 gage.



BOILER WITH DIVIDED-PASS BAFFLING

The boilers are supported on a steel chair at the rear, and cast-steel brackets, riveted to the sides of the front water legs, rest upon column supports.

The lowest row of tubes is encircled by L-tiles to within about 5 ft. of the rear water leg. This row of tiling serves as a roof for the furnace and combustion chamber and permits of a simple, standard arrangement of the stoker, with plenty of room to give the flames time to

burn out without an excessively high setting. The flame travels horizontally and the gases burn out in the combustion chamber before reaching the tubes.

The middle baffle rests upon the ninth row of tubes, with an opening both front and rear. The top baffle extends from the rear to within several feet of the front water leg, leaving an opening for the discharge of the gases from the boiler tubes. The gases entering the boiler divide into two streams, one flowing beneath and the other above the middle baffle. The gases flow under the boiler drums before passing to the smoke outlet.

Hydraulic Water-Turbine Governor

An improved governor for water turbines wherein floating levers have been dispensed with, is illustrated herewith. The governor sleeve is mounted on an aluminum crosshead *C*, which rises and falls with the sleeve *S*, it is adjustable to take up wear, and is prevented from revolving by stops. One end of the crosshead is directly connected to the piston valve *J* and the other end to the plunger of the oil brake *W*; this gives a direct force couple.

The compensating mechanism consists of a bronze sleeve *E* which is a sliding fit in the valve body *A*, and inside of which the plunger *J* works. The sleeve is connected to the piston of the servomotor, as shown, or to some part of the gate-regulating mechanism; therefore, every movement of the piston valve is immediately duplicated by the sleeve.

An oil brake *W* is provided with a wide range of adjustment by means of the check valve *Y*. This controls the too rapid action of the governor, and prevents the valve sleeves or compensator from interfering with the action of the pendulum.

The body of the oil brake is coupled to the valve sleeves by the rocking beam *Z*, so that when the speed is changed and the valve sleeve moves upward, the compensating action causes the oil-brake body to move downward, and *vice versa*. The check valve *Y* on the oil brake can be so adjusted that, however sudden the change of load, the action of the governor pendulum is not interfered with by the back action of the sleeve. The rocking beam *Z*, the sleeve *E*, and the oil-brake body *W* are held rigid between every movement of the pendulum.

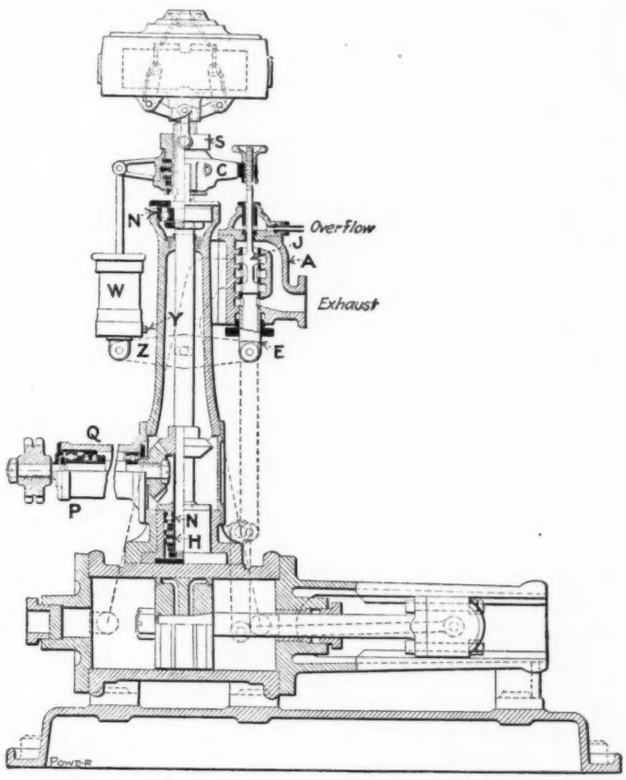
In the case of an impulse wheel with needle regulation or with a deflector, if it should be noticed that the governor carries a needle or deflector beyond the proper position and then oscillates several times after a change of load, it indicates that the oil brake is not slow enough in its action. The remedy is to close down the valve *Y* still further. If the governor does not open or close the nozzle properly, the valve on the oil brake is unscrewed a little more.

Another feature of the governor is that of throttling the exhaust instead of the supply to the valve *A*. This arrangement takes some of the strain off the piston valve, resists the wear, puts it in more perfect balance, and makes the relay piston easier to move.

The crosshead is fitted with double-ball thrust bearings to take the end thrust in either direction. The bottom of the main spindle also has a double ball-thrust bearing *H*, and the bearings at the top and bottom are ball-journal bearings, as at *N*.

The horizontal driving spindle is provided with two radial ball bearings *P* and a double thrust bearing *Q*, to prevent any tendency to end movement and take the thrust of the driving gear.

This governor was designed by Percy Pitman, 3 Willcott Road, Acton, London, W., England. Its claims are



SECTIONAL VIEW OF HYDRAULIC GOVERNOR

that it has a close speed regulation without hunting, that all parts are adjustable while it is in operation, and that it is automatic, hand or distant controlled. It is mounted on a self-contained bed.

Oil Engines in the United States—According to the report of the prime movers committee of the National Electric Light Association, there are at present 159 Diesel engine installations in this country. Thse are distributed geographically as follows:

State	No. of Installations	Number Engines	Total Horsepower
Arizona	6	11	3,505
Arkansas	1	1	120
California	1	1	60
Connecticut	5	8	2,195
Florida	8	32	10,720
Illinois	6	11	1,530
Indiana	7	15	2,905
Iowa	1	1	120
Kansas	6	8	1,355
Louisiana	7	12	1,800
Maryland	1	1	225
Massachusetts	15	31	6,615
Minnesota	3	4	740
Missouri	3	8	1,815
New Hampshire	2	4	1,350
New Jersey	6	7	1,050
New Mexico	3	3	845
New York	10	21	3,130
Ohio	4	6	1,350
Oklahoma	4	4	845
Pennsylvania	6	20	4,135
Rhode Island	7	13	2,640
South Carolina	1	2	395
South Dakota	1	2	450
Tennessee	1	1	225
Texas	36	46	8,915
Wisconsin	5	13	2,265
Hawaiian Islands	1	1	225
Mexico	2	4	785
Total	159	291	62,310

Reducing Smoke with the Steam Jet*

By Osborn Monnett†

SYNOPSIS—Why a steam jet reduces the smoke and how to install it. Calculating smoke density.

Having taken up the problem of draft, which must be settled before a successful furnace can be installed, the design of the furnace will be considered. Many attempts have been made to design a simple, hand-fired furnace which would stand hard usage and reduce the smoke to a minimum, but few such furnaces would stand a close Ringlemann chart reading, such as is demanded by the modern smoke ordinance.

The first setting to come into general use in this country was the standard horizontal, return-tubular setting with plain grates, it being the simplest and cheapest setting that could be devised for making steam. It was extensively employed in the East, burning anthracite buckwheat coal with forced draft, and naturally came into common use in the West for bituminous coals before the smoke problem became important. Thousands of these standard settings are scattered over the country today, giving fairly good results for all around use. However, with Western bituminous coals the settings permitted excessive smoke. When smoke became a nuisance, in the eyes of the law, various attempts were made to overcome the difficulty and still retain the simplicity of the original setting.

Steam Jets

The steam jet was probably the first and most common device for reducing smoke. Fig. 1 shows a typical setting with one in use. The function of the steam jet is to produce a mechanical mixture between the gases and the air coming in through the grate and over the fire. Elaborations of the plain, hand-operated steam jet have been made in great numbers. Automatic valves for turning on and off and operating various tips, flaps, panels, dampers, etc., are used in various systems and strong claims are sometimes made as to their beneficial action. Many of these claims are based upon the supposed dissociation of steam into hydrogen and oxygen, and the consequent increased combustion due to introducing this free hydrogen with its high B.t.u. value to be again united with the oxygen present in the furnace.

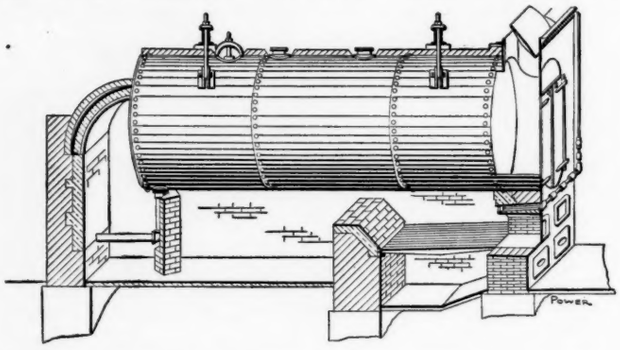


Fig. 1. Typical Setting with Steam Jet in Use

It must be remembered, however, that to separate a pound of steam into its elements, hydrogen and oxygen requires the same amount of heat that is given off when a pound of steam is formed by the union of hydrogen and oxygen, so that there is no thermal gain even if the steam is dissociated in the ordinary furnace, which is doubtful. If the action does take place there is bound to be a loss by radiation which could not be made up It is evident that the chief function of the steam jet is to mix the air and gases so that the latter may burn, if the temperature at the point of mixture is high enough.

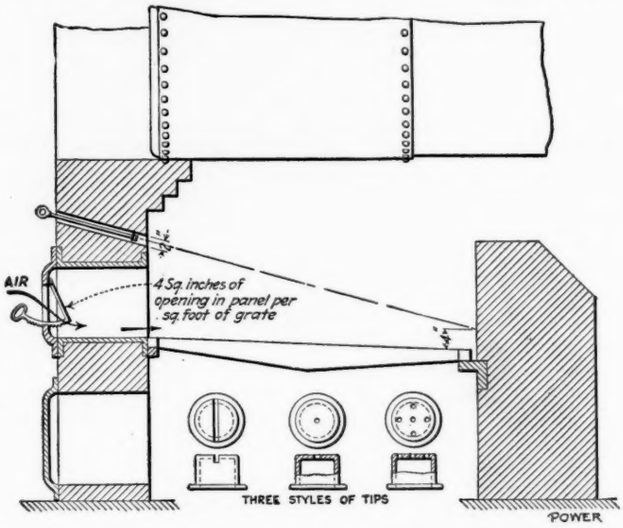


Fig. 2. Siphon Type of Steam Jet

The accompanying table represents a typical performance of an automatic steam-jet system on a plain horizontal, return-tubular setting carrying an ordinary working load. The table gives Ringelmann chart readings taken at 15-sec. intervals for a period of 1 hr. The blank spaces indicate no smoke. The results are reduced to the equivalent of No. 1 smoke and the mean density calculated as follows:

5 readings of No. 5 smoke	=	25	units of No. 1 smoke
1 reading of No. 4 smoke	=	4	units of No. 1 smoke
24 readings of No. 3 smoke	=	72	units of No. 1 smoke
4 readings of No. 2 smoke	=	8	units of No. 1 smoke
34 readings of No. 1 smoke	=	34	units of No. 1 smoke
	Total	143	

The smoke unit is defined as 1 min. of No. 1 smoke, which is of 20 per cent. density. As the readings were taken every 15 sec., it follows that one-fourth the sum of the units in the foregoing table gives the smoke units for the observation. Thus

$$\frac{143}{4} = 35.75$$

The calculation for density is made by multiplying the smoke units by 20 per cent. and dividing by the number of minutes of observation, thus

$$\frac{35.75 \times 0.20}{60} = 11.9 \textit{ per cent.}$$

A plain setting and steam-jet equipment, either manually operated or automatic, will usually average from 8 to 12 per cent. smoke density. It has been satisfactorily demonstrated that a well designed, hand-fired furnace, handled properly, can be run within 5 per cent.

*Copyright, 1914, Osborn Monnett.
†Smoke inspector, city of Chicago.

density and 2 per cent. has been obtained by careful operation. In reducing the density of smoke from a plain setting with steam jets, the trouble has been that immediately after firing an excess of volatile matter is distilled and carried off without being properly mixed with sufficient oxygen at a time when the temperature is high enough to produce complete combustion. It is evident that additional equipment is needed to insure a proper mixture. The combination of an automatic steam jet and brickwork suitably designed for furnaces such as will be described later, makes a good outfit for smoke suppression.

An ordinary hand-operated steam jet accomplishes a mixture of the air and gases, but its efficiency can be greatly increased by making it of the siphon type. This

RINGELMANN CHART READINGS

A. M. 10:00	0	15	30	45	A. M. 10:00	0	15	30	45
1					31				
2				1	32				
3	3	3	3	3	33				
4	3	3	3	3	34				
5	3	2	1	1	35				
6	1	1			36				
7					37				
8	1	1	1		38				
9					39			5	5
10					40	3	3	1	
11					41	1	1		
12					42				
13					43				
14	3	3	2	2	44		1	1	1
15	2	1			45	1	1	1	
16					46				
17					47			1	3
18					48	3	5	5	3
19					49	1	1	1	
20					50				
21					51				
22		3	4	3	52				
23	1	3	3	3	53				
24	3	1	1		54				
25					55				5
26					56	5	3	1	1
27					57	1	1	1	1
28					58				
29					59		1	1	1
30									

Minutes observation, 60. Smoke units, 35.75. Per cent. density, 11.9.

is done by placing the jet in an outer pipe 1½ or 2 in. in diameter, as shown in Fig. 2. The expanding steam fills the tubes and causes a suction of air into the furnace, where it is mixed with the volatile matter distilled after firing. The direction of the jet should be such as to strike the bridge-wall about 4 in. above the grates, as indicated in the drawing. Three forms of tip are shown at the bottom of the drawing.

Quick Repair Job—An unusual boiler repair job was carried out recently when sixteen large cracks in the firebox of a large boiler were welded and the boiler was placed in service again within 48 hours' time, two men doing the job.

Improved Wing Turbine Blower

In Figs. 1 and 2 is shown the Wing Type E turbine blower, in which is incorporated a new feature in fan design. With ordinary straight casings, the air being

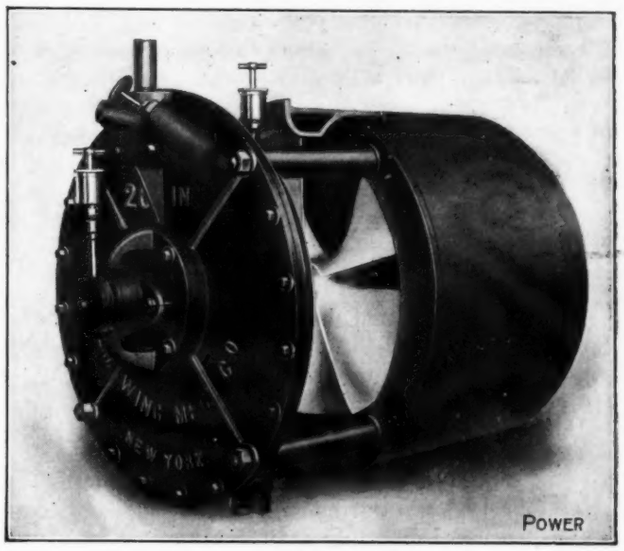


FIG. 1. BLOWER CASING WITH PORTION CUT AWAY

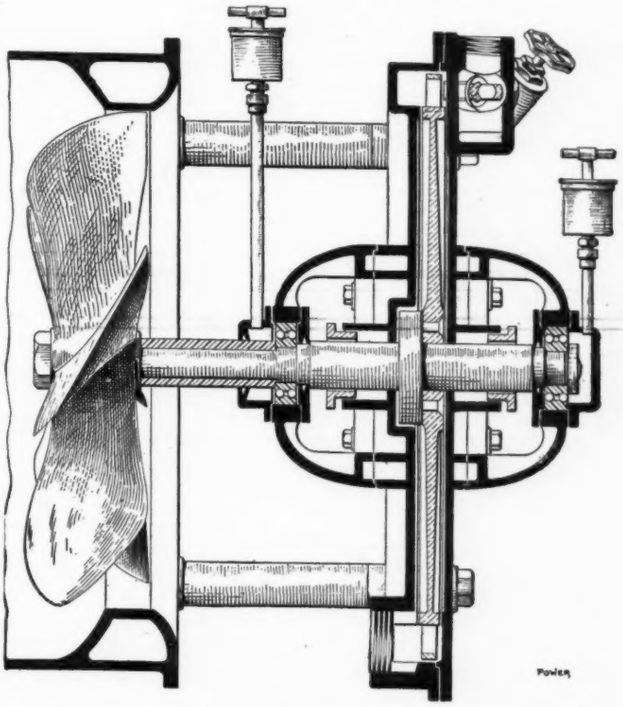


FIG. 2. SHOWING DETAILS OF TURBINE BLOWER

thrown outward centrifugally strikes the casing, and although much of the air is delivered, considerable leaks back when it impinges against the casing. In addition to the air loss, there is a pressure loss due to the eddy currents caused by the impact.

In the casing of this blower, made by the L. J. Wing Manufacturing Co., 352-362 West Thirteenth St., New York City, the direction of the air is gradually changed

from the radial or centrifugal—that is, out from the center—to axial, along the shaft. By the sweep of the patented expanding casing, an increase in fan efficiency of over 50 per cent. against the straight cylindrical casing is obtained. The five-bladed fan, of the propeller type used, is capable of delivering large volumes of air at pressures exceeding 4 in. water gage.

Fig. 2 is a sectional view through the unit, and shows the expanding casing, to which the turbine casing is secured by four bolts with sleeves. The fan and turbine are mounted on a steel shaft, with heavy ball bearings on either side of the turbine, so that there is no overhang to the machine. The machine will operate against either high back pressures or vacuum, and the exhaust steam may be turned into the ashpit if desired, or into the heating system or feed-water heater. The fan casing is secured in the masonry of the boiler wall, and whether the steam is turned into the ashpit or the heating system, or exhausts to the atmosphere, the machine is practically noiseless in operation.

An Interesting Cylinder Failure

By H. B. Boydon

This failure occurred on a horizontal cross-compound Corliss engine 24 and 48 by 48 in. with an auxiliary high-pressure cylinder 20-in. diameter arranged tandem to the low-pressure cylinder, as shown in Fig. 1.

During summer the engine is operated condensing with a 1 to 4 cylinder ratio, the auxiliary high-pressure piston rod being disconnected from the tail rod of the low-pressure cylinder. During winter the engine operates noncondensing, exhausting against a varying back pressure into steam-heating mains. The auxiliary high-pressure cylinder is then in service, giving a resultant cylinder ratio of 1 to 2.36. Fig. 1 also shows the arrangement of the live-steam lines to the two high-pressure cylinders, the exhaust piping between these cylinders and the vertical receiver and from the receiver to the low-pressure cylinder. The engine was designed for an initial pressure of 140 lb.

In winter the engine is started from the throttle valve on the 24-in. cylinder, brought up to speed and the generator synchronized and put on the busbars. While being

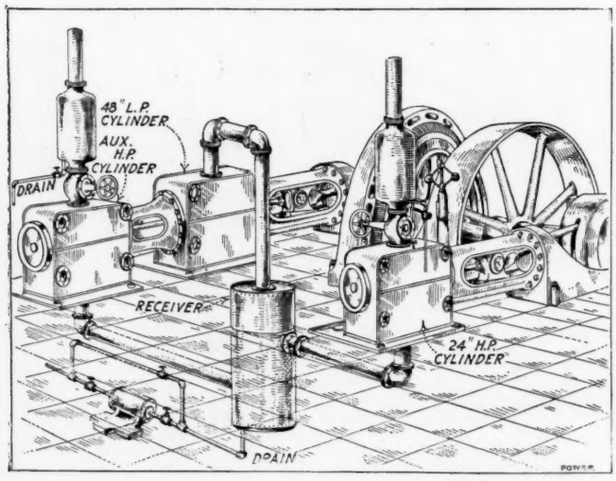


Fig. 1. Showing the Engine Piping

synchronized the throttle valve on the 20-in. cylinder is opened.

One winter morning just as the engine was up to speed, the steam chest of the 20-in. high-pressure cylinder cracked, as shown in Fig. 2. It will be noted that this crack extended the entire length of the steam chest except for the two outside ends of the valve chambers and entirely through the central webs of the steam chest.

A chart from a recording gage on the main steam header shows that when the accident occurred the steam pressure was about 162 or 163 lb. gage. On testing this gage it was found that 160 lb. on the gage was actually 155 lb., and that it was correct when reading 170 lb. It is, therefore, probable that at the time indicated the actual

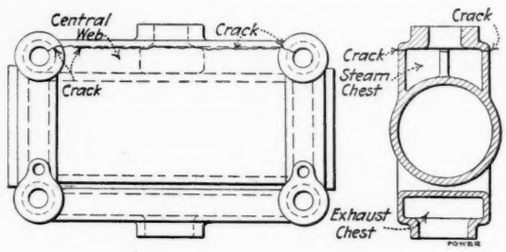


Fig. 2. How the Cylinder Cracked

steam pressure at the point where this gage was connected was about 158 or 159 lb.

From the main header the steam to this engine passes through two reducing valves, one on the steam pipe of each high-pressure cylinder. There is no evidence to show what the pressure was on the low-pressure side of the reducing valve. If it be assumed that the reducing valves were inoperative, the pressure at the engine-throttle valve at the time of the accident was probably about 158 lb. gage. This pressure would be insufficient to burst the cylinder.

The two engineers on watch at the time of the accident were questioned as to the facts in the case. It was stated by both men that it was customary before starting up an engine to open the drains and feel the discharge pipes to know whether or not they were in operation, but if this was the custom, it was done in a slipshod manner, and definite information was not gained as to whether the drains were open or closed, for examination of the drain pipe from the receiver separator on the steam line to the auxiliary cylinder showed that it was completely blocked up with a stiff pasty deposit. There was some difference of statement as regards the actual condition, at the time of the accident, of the throttle on the cylinder which broke. One man said it was closed, the other stating that immediately after the accident he

closed it, it being open about an eighth turn. By testing the valve it was found that this opening was not sufficient to move the valve off its seat, and it is entirely probable that the valve was actually shut when the accident occurred. Both men agreed that the engine was up to speed and was being made ready to be synchronized and connected to the busbars for carrying the load. Both also stated that there was no sound to indicate trouble. It is very doubtful if any sound could have been heard as the clatter of the valves of an engine running at full speed at no load is quite considerable. This would especially be the case as the clatter of the valves on the low-pressure cylinder would occur practically at the same time as noise in the auxiliary cylinder.

Referring to Fig. 1, it will be noted that the exhaust from the 24-in. cylinder enters the vertical receiver at a point above the exhaust from the 20-in. cylinder, also that the receiver is drained from the lower end through a trap which is fitted with a bypass. By trial it was found that the valve on the bypass of the trap was closed, that the inlet valve to the trap was open, but that the discharge valve from the trap was closed. No other drain being provided on the receiver, there was no means of getting rid of any accumulation of water in the lower portion of it. There is no exact information as to the steam pressure in the receiver at the time of the accident. It is probable, however, that it was somewhere between 2 and 6 lb. gage. The evidence, therefore, showed that the cylinder wrecked had a receiver pressure not exceeding 5 or 6 lb. and had a closed throttle valve.

The conclusion reached after examination of the evidence and the condition of the engine and piping was that the rupture was caused by water entering the cylinder from the receiver; that the piston in this cylinder operating without steam pressure on it, acted as a pump piston pumping water into the cylinder through the exhaust piping and exhaust valves, being assisted in this action by the pressure of the steam in the receiver, which in itself was probably sufficient to flood the cylinder with water. The exhaust chest was protected by the exhaust valves from rupture, and the steam chest being the weakest part, let go.

It is probable that the great majority of engines wrecked when starting up are not damaged by water coming in with the steam, but by water which is drawn into the cylinder through the exhaust valves from a flooded exhaust pipe caused by inadequate drainage of the exhaust piping.

Distribution of Heat in Turbine Plants

By H. Fothergill

SYNOPSIS—Simple diagrams representative of the distribution of heat in the several types of steam-turbine plant, which should help in the choice of a plant for a particular purpose.

Many diagrams showing the distribution of the heat obtained from a given quantity of coal have been illustrated from time to time, but the diagrams shown in Figs. 1 to 5 are perhaps the most simple and explicit yet devised for the purpose of illustrating graphically in connection with steam-turbine plants the percentage of heat units utilized and the percentage lost, of a given number of units which represent the thermal value of the coal.

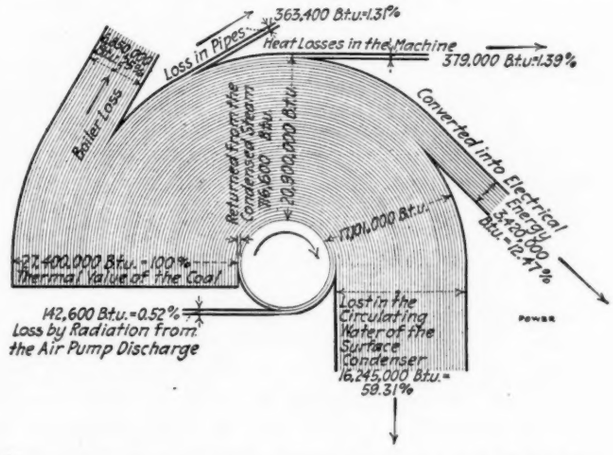


Fig. 1. Heat-Distribution Diagram of 1000-Kw. High-Pressure Condensing Engine

The calculations on which the diagrams are based were taken from actual results obtained by the Allgemeine Elektrizitäts Gesellschaft from their turbines. In addition to the usual high-pressure condensing turbines which have now become so popular in replacing the reciprocating engine in most modern electric-power plants, the A. E. G. manufacture back-pressure turbines, reducing turbines, low-pressure turbines and mixed-pressure turbines.

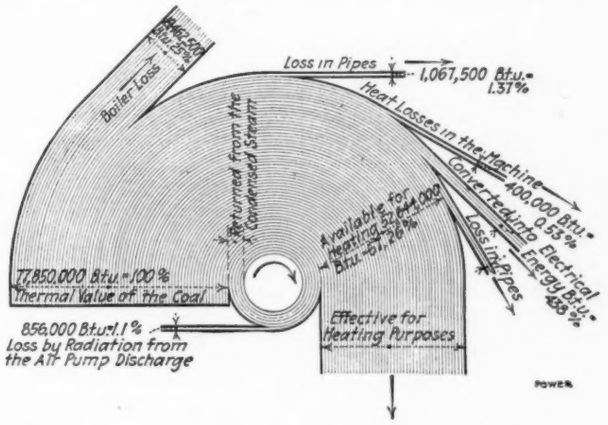


Fig. 2. Diagram from 1000-Kw. Back-Pressure Turbine

It is not proposed in this article to enter into theoretical calculations or to consider the advantages and

disadvantages of the various types of turbine referred to. The object is to lay before the engineer a simple diagram representative of the distribution of heat in each type of plant, so that he will be able to see at a glance which particular installation he should adopt and the percentage of heat units which he will be able to utilize beneficially.

High-Pressure Condensing Turbines

A diagram showing the heat distribution in a high-pressure condensing turbo-generator plant is illustrated

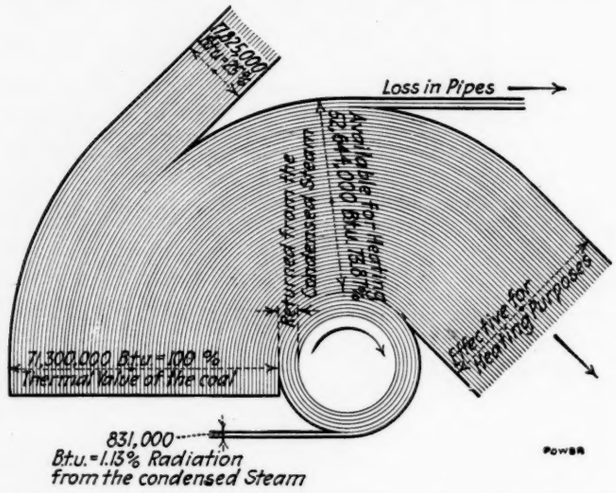


Fig. 3. Heat Distribution from Low-Pressure Boiler

in Fig. 1. To those who are not familiar with thermal-balance diagrams, the enormous quantity of heat which is carried away by the condensing water and lost, will no doubt seem surprising. With the object of avoiding this wastage, various combinations have been suggested. There are many plants which now use steam for heating

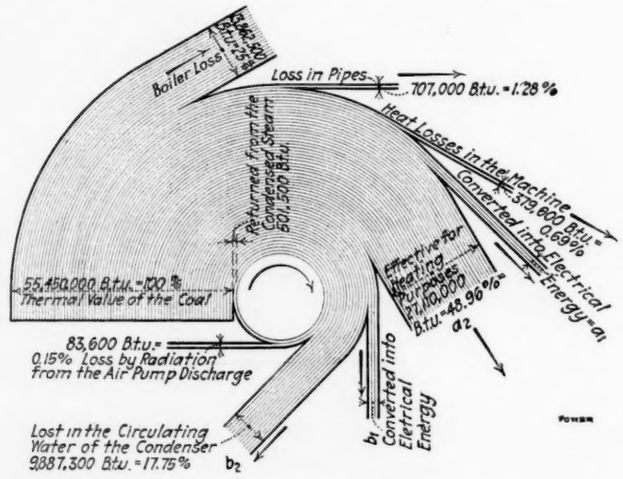

Boiler Loss
Loss in Pipes
707,000 B.t.u. = 1.28 %
Heat Losses in the Machine
Converted into Electrical Energy = a1
Returned from the Condensed Steam
801,300 B.t.u.
55,450,000 B.t.u. = 100 %
Thermal Value of the Coal
Effective for Heating Purposes
83,600 B.t.u. =
0.15% Loss by Radiation
from the Air Pump Discharge
Converted into Eletrical Energy
Lost in the Circulating
Water of the Condenser
9,887,300 B.t.u. = 17.75%

Fig. 4. Diagram from 1000-Kw. Reducing Turbo-Generator Giving Exhaust Steam for Heating Purposes

as well as for power purposes, most common are those installed in large private undertakings, offices, hotels, chemical and celluloid works, paper mills, etc., and in such cases the usual practice is to install either a low-pressure boiler, specially for heating purposes, or to take live steam from the main boilers through a reducing valve. In this direction greater economy can be obtained by increasing the pressure of exhaust steam from a turbine and using this steam for heating purposes. Although this arrangement necessitates a back pressure on the turbine, the system will utilize a greater percentage of heat than a simple high-pressure condensing turbine.

Back-Pressure Turbines

Fig. 2 is a diagram showing the heat distribution for a back-pressure exhaust turbine. The steam consumption of a 1000-kw. back-pressure A. E. G. turbine is 47.5 lb. per kw.-hr., with an exhaust pressure (back pressure) of 28.5 lb. per sq.in. Over two-thirds of the total heat value of the full amount becomes available for heating purposes. This figure will naturally be subject to slight variations depending on the relative position of the turbine and the apparatus to be heated, the lagging of the exhaust-pipe line, etc.

Fig. 3 demonstrates the heat distribution of a low-pressure boiler, and based on a steam pressure of 28.5 lb. per sq.in. it would require about 5600 lb. of coal per hr., to give the same heating value as the exhaust steam from the 1000-kw. turbine with the same boiler effi-

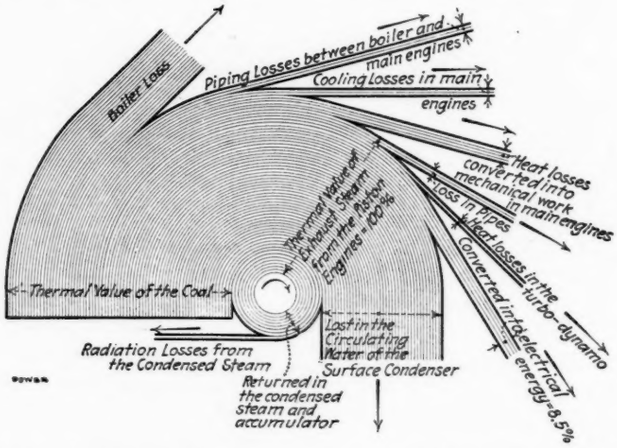

Boiler Loss
Piping Losses between boiler and main engines
Cooling Losses in main engines
Heat losses converted into mechanical work in main engines
Loss in Pipes
Heat Losses in the Turbo-dynamo
Converted into Electrical energy = 8.5%
Thermal Value of Exhaust Steam from the Main Engines = 100%
Thermal Value of the Coal
Lost in the Circulating Water of the Surface Condenser
Radiation Losses from the Condensed Steam
Returned in the condensed steam and accumulator

Fig. 5. Heat Distribution in an Exhaust-Steam Turbine

ciency. In addition 2200 lb. per hr. is required for power production, or a total of about 7800 lb. per hr., while with the back-pressure turbine only 6150 lb. of coal per hour is necessary. This represents a saving of 1650 lb. of coal per hour.

Reducing Turbines

It is inadvisable to use the back-pressure turbine when the amount of steam required for heating purposes is independent of that required for power production. For instance, the output in kilowatts may be large when the demand for heating steam is small, and *vice versa*. In such a case the reducing turbine is to be recommended. This is arranged so that a portion of the steam on its way through the turbine may be taken off for heating purposes, the remainder passing along to the exhaust in the usual way.

Fig. 4 demonstrates the heat distribution of a 1000-kw. reducing turbo-generator giving 22,000 lb. of steam per hour for heating purposes. In this diagram $a_1 + b_1$ is

usually a constant as also is $a_2 + b_2$. In the extreme case, however, of the whole of the exhaust being used for heating purposes the values of b_1 and b_2 may be 0.

Taking the most ordinary base, namely, a unit of 1000 kw. and giving for heating purposes 22,000 lb. of steam per hour, about 4371 lb. of coal per hour would be required, while for working with a normal condensing turbine, and a special boiler for heating, about 5280 lb. of coal would be required.

Low-Pressure Turbine

This class of turbine is adapted to utilize exhaust steam from reciprocating engines, steam hammers, etc. Theoretically it is possible to get as much work out of one pound of dry-saturated steam at 15 lb. abs. pressure expanded down to 0.85 lb. abs. pressure, as out of one pound of superheated steam at 470 deg. F. and 170 lb. abs. pressure per sq.in. expanded down to 17 lb. abs.

While the reciprocating engine cannot use a higher vacuum than 85 to 88 per cent. with economy, owing to the large size necessary for the low-pressure cylinder and the consequent radiation and friction losses, the steam turbine can utilize with advantage a vacuum as high as 96 to 99 per cent.

The A. E. G. exhaust-steam turbine is, to all intents and purposes, the low-pressure stage of a high-pressure turbine. A steam accumulator may or may not form part of such an installation, according to circumstances.

Fig. 5 illustrates the heat distribution of a 1000-kw. exhaust-steam turbine. The inlet pressure is 15.6 lb. per sq.in. and the outlet (condenser) pressure is 0.71 lb. per sq.in. abs. The steam consumption is 30.8 lb. per kw.-hr.

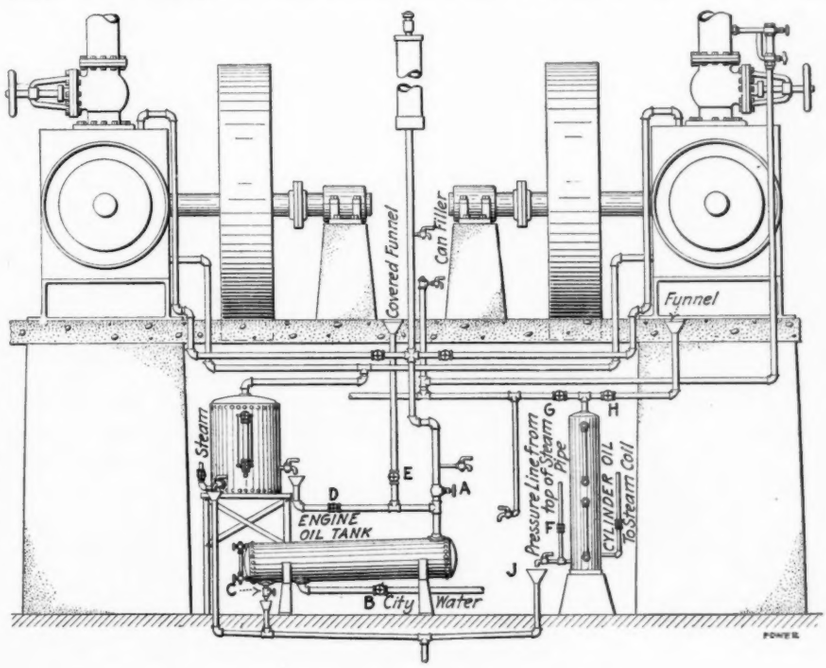
Mixed-Pressure Turbines

Wherever, owing to the intermittent nature of the work performed by the reciprocating engine, the flow of exhaust steam is irregular, the combined live- and exhaust-steam turbine has a large sphere of usefulness. The turbine for this work is similar to the high-pressure condensing turbine, except that the exhaust steam from the reciprocating engines is introduced into the low-pressure stage. This type of turbine is specially designed so that when the input of exhaust steam is insufficient to meet the load, live steam is admitted to the high-pressure stage. Both live- and exhaust-steam inlets are controlled by an automatic governor to prevent racing.

Making an Oiling System

By J. C. Hawkins

The oiling system shown and described herewith has given excellent results for years in a power plant having four large and several small engines. The engine oil system consists of a 40-gal. galvanized, closed house tank placed horizontally, with one end about 2 in. lower than the other. This tank is connected to the system at its upper end. There is also a water connection at the lower end, a drain to the sewer, connections to a filter, and a filling connection for putting in new oil, gage-glass, etc.



The Oiling System as Installed

The system operates as follows: The tank is filled with oil and the water pressure of 55 lb. from the city mains admitted at the bottom forces oil up into the system. To fill the pressure tank, the oil valve A and the water valve B are closed, and the drain valve C to the sewer is opened. Then the oil in the filter is drained into the funnel and the valve D is opened enough to let the oil run into the tank. When the water has drained out of the tank, valve C is closed, and as the tank becomes full or the filter is empty, valve D is closed and valves A and B opened.

While the tank is being filled, the engines get oil from the standpipe in the engine room. This pipe is 6 in. in diameter, 6 ft. long and placed several feet above the level of the engines; it is connected to the system by a 1-in. pipe. There is an air cock at the top which lets the air flow in or out, but it does not allow the oil to escape. This insures the standpipe always being full of oil when the system is in operation. The supply will last until the tank is full and in operation again, when the standpipe will be refilled as the pressure is turned on.

When it is necessary to put new oil in the system, we use a pipe leading from the tank through the engine-room floor with a funnel, the end of which is flush with the floor and fitted with a tight cover-plate when not in use. A spigot is put in the barrel and the oil is drained directly into the pressure tank from the barrel with valves A, B and D closed and valves C and E

open. There is a ½-in. branch pipe from the main oil-supply header to each engine. This comes up over the top of the frame and branches to the crank, the main bearing, the eccentrics and the crosshead, and a separate line runs to the outboard bearing.

All pipe above the floor is of nickel-plated brass, and a suitable regulating valve with a sight feed is placed at each outlet. A faucet is placed below the standpipe in the engine room for filling the oil cans, with a tray to catch the drippings. There is also a faucet in the line in the basement. All oil after running over the bearings returns to the filter through a main return line. The filter is of the usual construction and the trays are submerged in water. The oil passes down through charcoal into a pipe leading to the bottom of the chamber, and returns through hot water passing over the edges of the trays to the reserve chamber. The filter is further aided in throwing down the dirt by heating the water through which the oil passes; this is done by a steam coil in the lower part of the filter.

While the filter is being cleaned, the return oil is drained into a barrel and filtered later. The pressure tank will supply the engines with oil for about 26 hours, and is filled once every 24 hours, the filling requiring about 15 min. The system is so arranged that when it needs cleaning steam can be turned in and the sediment blown out of part of the piping at a time while the plant is in operation.

The cylinder-oil system is operated in practically the same manner as the engine-oil system except that it has a steam coil placed in the pressure tank to keep the oil hot. The pressure for operating is taken from the bottom of the steam line at its highest point and the pressure pipe is left bare to act as a condenser. The pipe is therefore full of water, and the pressure at the bottom of the oil tank is equal to the steam pressure plus that due to a head of water 24 ft. high. This gives plenty of excess pressure to feed the oil. A main header is connected to the tank with ⅜-in. branches to all the engines.

Unlike the engine-oil system, there is no standpipe. A 1-qt. hand oil pump is placed on each cylinder, and used when the tank is being refilled with new oil. This is done by closing valves *F* and *G* and opening valves *H* and the drain valve *J*. The oil is put into the tank through a pipe which comes through the floor with a funnel fitted with a tight cover when not in use.

The system is not patented, and any engineer is at liberty to use it with whatever modifications are required to fit the conditions.

Machinery Designing vs. Repairing Facilities

By Edwin W. Creed

At different times in the writer's experience as an engineer, he has had strong reasons for thinking that some power-plant machinery designers either had little or no experience in practical operation or they did not realize that repairs would ever be necessary.

In one case, the valves of a plunger power pump required frequent grinding. The suction valves were easy to get at, but the discharge valves, because of the close proximity of the air chamber, were almost inaccessible. The valve chambers were closed with a plug, which also acted as a guide for the valve stems. It had a square head on top for turning with a wrench: The difficulty was in removing and replacing the caps as a ratchet socket wrench was required to turn them.

In another plant there was a large vertical, cross-compound engine. After some three years' service the frame head joint on the high-pressure cylinder began leaking badly. To put in a gasket, it was necessary to remove the cylinder lagging, the valve-gear and the piston, and move

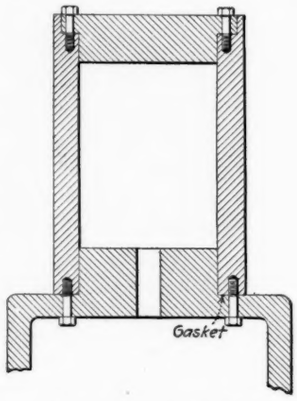


Fig. 1. Design of Old Joint

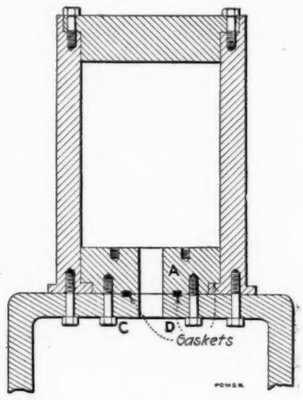


Fig. 2. Design of Proposed Joint

the cylinder clear of the frame head. It took about a week to do this job and it has been done twice since. As this kind of joint is always likely to leak, it seems that this part might be so designed that the joint could be made over with less work.

Fig. 1 shows the construction of the frame head and Fig. 2 shows how I think it might be made. It is not necessary to disturb the cylinder to put a new gasket in place. With the piston out of the way, eye-bolts can be screwed into the head block *A*, to lift it out of the cylinder, after removing the stud nuts *C* and *D*. This may not be practical, but it at least shows that there are more ways than one of doing things.

In the same plant, there were three horizontal, cross-compound engines, with the steam and exhaust valves in the heads. Every time the cylinder or piston packing

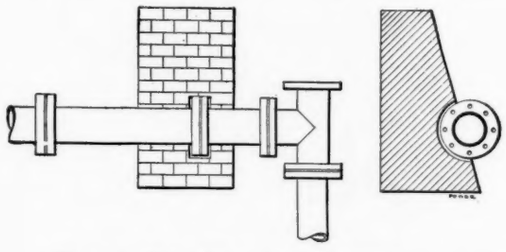


Fig. 3. Two Views of the Pipe and Brick Foundation

rings were examined, the back head had to be removed. The head joints were so designed that the only way the nuts on the studs could be removed or put back was with a set and sledge-hammer. No wrench I ever saw could be used on them.

I have several times helped to take down closed heaters of the horizontal type, because of leaky tubes. These heaters were in the exhaust line to the condensers and were heavy and difficult to handle. The engines were

about 1500 hp. Usually, the coils to be repaired were sent to the manufacturer and one of two things had to be done before the engine could be run; either put back the shell after taking out the coils, which means extra work, or else fit in a length of pipe.

Another difficulty with a closed heater is that the coils eventually become coated with cylinder oil, thus reducing their efficiency. Generally, no provision is made for getting at the coils to clean them; therefore, why not provide against these contingencies when designing a heater? Engineering papers advertise a closed heater which the builders claim has solved these problems, and, so far as I know, they have made good.

Criticism might be made concerning piping job layouts. It is easier to put up new work than it is to make over flange joints, or to make piping repairs after the piping has been in service several years. I recently saw a line of 22-in. flanged cast-iron pipe put up after much time had been spent in measuring and checking up the plans. The pipe and fittings were numbered, and the steam fitters given a blueprint, showing the location of every piece. The plans called for running this pipe so close to the brick foundation of the engines that part of the foundation had to be cut away. At one place the blueprint placed a flange joint opposite an engine foundation, and two men were as many days cutting away enough of the brick to make room for the flanges. Special socket wrenches had to be used to tighten up the bolts.

If that joint ever leaks and has to be made over, there is just one way to do it, after the nuts are well rusted; that is, to break the joints on either side, and lift the pipe out bodily to a position where a man can get all around it.

Fig. 3 gives two views of this pipe and the engine foundation. By changing the positions of the two lengths of pipe, time and labor could have been saved; the joints would then come where they would be accessible. This was suggested to the steam fitter in charge of the job, but he insisted on following the blueprint.

The moral to be drawn is that designers should be men of practical experience or that the designs and plans should be submitted to a thoroughly practical man for approval, preferably the man who will have charge of the operation of the machinery or the plant.

Large Engine Pillow Block Welded

By J. E. Rork

Some engineers are skeptical of welding, while others employ it as a last resort. It is impossible to give a set rule which would cover all emergencies when welding should be used, although it is safe to say that any casting which has had machine work done upon it can be successfully welded. In emergencies where the factor of time saved is of vital importance, oftentimes a large saving can be made by having the repair done by a competent welding concern.

The illustration shows an 8000-lb. pillow block to a 1200-hp. engine which was welded last winter. The break was caused by water getting into the cylinder and the backward thrust breaking off the back of the pillow block. This was a serious accident, it being impossible to obtain a new block without long delay; as it was, it looked like a long shutdown of the entire plant.

The welding was done at the mill, it being more feasible to move the welding equipment than to attempt to move an 8000-lb. casting any distance. A beam track was erected just outside the engine room and an inclosure made with canvas. The casting was chipped from both sides, leaving a web in the center, the two parts forming an "X" when placed together. The broken back was held in place by heavy bars of iron which were left on during all the welding. A temporary furnace was built around the portion to be welded, and the casting was preheated by two oil burners.

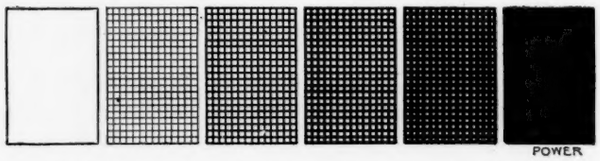
Two complete welding outfits were used on the job and about 1000 ft. of oxygen was consumed before the weld was finished. As saving time was the main factor in this repair, welding was continued day and night for 36 hr. The welding was finished in the evening, after which the casting was again heated, banked and allowed to cool over night. This precaution was taken to remove all the internal strain which might be caused by uneven cooling. The next morning the pillow block was put into place and the engine was soon in operation. This repair has stood a test of ten months' service and the engine is in operation today.

Showing Weld in Pillow Block

This is only one instance in which welding has proved a sure saving of much money and unnecessary delay. The welding of large pieces is finding favor among engineers and is an economical process in a breakdown.

Convenient Ringelmann Smoke Scale

The ordinary Ringelmann four-scale chart for grading the density of smoke measures 8x24 in., and must be posted about 50 ft. distant from the observer. For accurate reading this is perhaps the best size of chart and

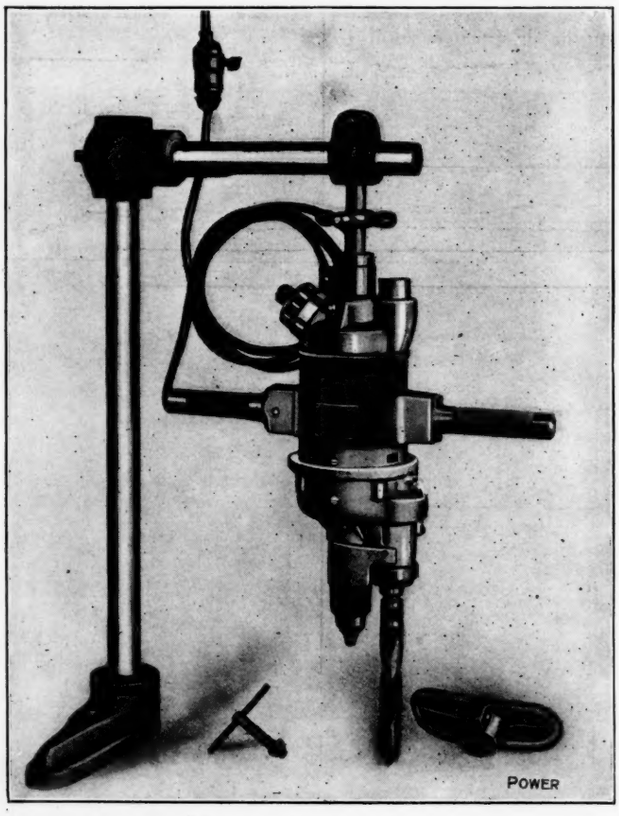


ACTUAL SIZE OF CHART TO BE USED AT ARM'S LENGTH

the proper distance, but the Hamler-Eddy Smoke Recorder Co., Chicago, Ill., is issuing a chart, illustrated herewith, which is ¾ in. high and 3¼ in. long, printed on a 2½x4¼-in. card. A reading may be taken at arm's length. It is convenient to carry in the pocket, and for ordinary use is fairly accurate.

Stow Portable Drilling Machine

The two-spindle, two-speed drill illustrated, is designed for use as a portable machine. The smaller spindle is fitted with a Jacobs chuck for holding straight-shank drills up to ½ in. in size, and has a speed of 450 r.p.m. The larger spindle takes a Morse taper drill up to ¾ in.



PORTABLE DRILLING MACHINE

and has a speed of 225 r.p.m. A chuck can be attached to the larger spindle if desired.

The two-spindle arrangement gives the tool a wide range of application, and the spindles can be reversed for tapping operations. This machine, manufactured by the Stow Manufacturing Co., Binghamton, N. Y., is furnished for both alternating and direct current, the electric connection being arranged to fit any ordinary lamp socket.

Universal Packing Hook

Every engineer realizes the difficulty which he has encountered in using the ordinary design of packing hook where space is restricted between the crosshead frame and the stuffing-box. This difficulty seems to have been eliminated to a great extent by the type of packing hook illustrated herewith; it consists essentially of a universal joint between the worm end and the handle.

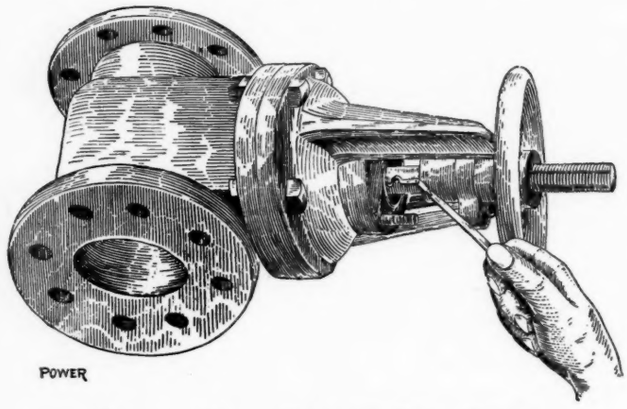


FIG. 1. USING TOOL ON GATE VALVE

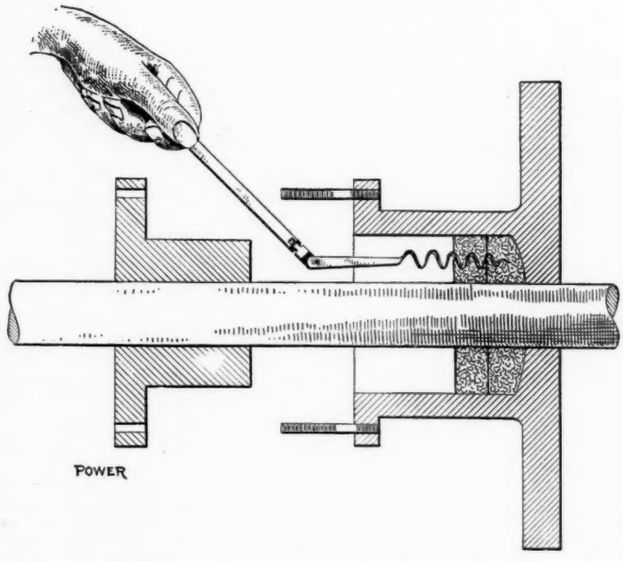


FIG. 2. TOOL AS USED WITH ENGINE STUFFING-BOX

The hook, which is manufactured by the Universal Tool Co., Box 756, Waterbury, Conn., can be used in removing packing from any type of stuffing-box on engines or pumps, several sizes being included in each set. Fig. 1 illustrates the hook as used with a gate valve; Fig. 2 shows how it is used in removing packing from the stuffing-box of an engine or pump.

Editorials

Power-Plant Legislation

The United States has less legislation relating to boilers than any other industrial country—and more boiler explosions.

The opinion that that government governs best which governs least has met with too general an acceptance.

The right of a property owner to do as he pleased with that which was his, leaving to those who were injured reparation only through the courts, has been carried too far.

In our table of boiler explosions, printed in the issue of June 30, there were mentioned, all told, 500 boiler accidents, including tube ruptures and blowoff failures, many of which resulted in fatal injuries. Officials of three different boiler-insurance companies announced not long ago that their losses from tube failures, etc., amounted, in the aggregate, to more than those from complete explosions. In the five hundred accidents of which we were able to get any news, 171 people lost their lives and 387 were injured. Our reports covered the property loss in only 163 of these accidents, but this totaled $213,644. It is readily conceivable that the total loss in all the accidents that occurred would be very far in excess of that figure.

Most of these disasters were preventable by the exercise of ordinary human foresight and intelligent supervision. Had skilled inspection and safe operation been imposed, the saving would have been worth many times what it cost.

For thirty-odd years POWER has been urging legislation to this end. It has been an up-hill fight. Users of boilers and employers of engineers saw in it only an attempt to place upon them burdensome restrictions, to subject them to the extortions of another set of grafting public officials and to curtail their labor market. On the other hand, although their leading organization, the National Association of Stationary Engineers, has actively advocated such legislation, many operatives in charge of the boilers and engines have opposed it through their fear of being unable to qualify before a board of examiners and obtain licenses.

Against these influences and the general inertia, such laws were procured in a few states and cities, and finally Massachusetts, under the impetus of a particularly disastrous explosion, adopted laws which provided not only for the inspection of boilers and the examination of the men who should run them, but for a "Board of Boiler Rules" which specifies how boilers shall be constructed, what material may be used, how the accessories shall be connected, etc

Like legislation has been adopted by Ohio and Detroit, and is under consideration by the legislatures of many other states. Some of the Canadian provinces have also established boards of boiler rules, and others of our own states and cities have less comprehensive regulations governing the pressure allowable with certain construction. Two aspirants for degrees in one of our Western colleges have demonstrated the impossibility of making a boiler which would be acceptable in all of nineteen states, provinces and cities having such regulations.

This condition, which promises to become more onerous and complicated through the extension of such legislation and the adoption of still other incongruous regulations, is a serious one for the boiler makers. Each boiler must be built with a knowledge of where it is to go, and must stay there. Boilers cannot be built for the general trade, nor for stock, and various kinds of plate and material must be kept on hand to meet the views of different boards and inspectors. Furthermore, the contractor or other nomadic user of boilers may find his outfit, designed to meet the requirements of one locality, entirely outlawed in another.

Recognizing the growing importance of the matter, the American Boiler Manufacturers' Association, at its New Orleans meeting in the spring of 1912, adopted a resolution urging uniform boiler legislation in all states. The National Association of Tubular Boiler Manufacturers, under the solicitation of Thomas Durban, of the Erie City Iron Works, has done still more aggressive work in this direction, having held a meeting at Pittsburgh for this special purpose, at which were present boiler makers and inspectors from all over the country; a later meeting in Chicago especially for consultation with the steel manufacturers, and having opened correspondence with the governors and the leaders of legislation in all of the states, urging the necessity of legislation concerning the construction, installation and operation of boilers and the desirability of uniformity in such legislation.

If there is to be a great forward movement along this line, it is essential that it should be intelligently directed. The legislator, knowing little of the subject, torn, twisted and importuned by conflicting interests, should have something to which he can turn as a guide and standard; some proposition the adoption of which is so obviously the thing to do that his warring constituents will have no leg to stand upon.

The one conspicuous logical authority for him to look to is the big national professional society which is concerned wtih such matters, the American Society of Mechanical Engineers. And this society, too, is alive to the situation and has already taken action which will enable it to respond fully and intelligently to this demand upon it.

A committee consisting of John A. Stevens, consulting engineer and ex-member of the Massachusetts Board of Boiler Rules, representing the users; William H. Boehm, of the Fidelity & Casualty Co., representing the insurance interests; Profs. R. C. Carpenter, of Sibley, and E. F. Miller, of the Massachusetts Institute of Technology, representing the scientific side; Charles L. Huston, vice-president and works manager of the Lukens Iron & Steel Co., representing the steel manufacturers; Past-President E. D. Meier, president and chief engineer of the Heine Safety Boiler Co., and Richard Hammond,

president of the Lake Erie Engineering Works, representing the boiler makers, has been appointed "to formulate standard specifications for the construction of steam boilers and other pressure vessels and for the care of the same in service." This committee has prepared a tentative report including not only boiler rules and specifications, but, under the "care of same in service" clause, forms of law which will put the proposed regulations into effect. Over two thousand copies of this report have been sent out to specialists in the lines affected for criticism and suggestion.

A hearing will be held at the Engineering Societies Building, New York, on September 15, to which all in any way interested are invited. Discussion should be sent to the committee at the headquarters of the American Society of Mechanical Engineers, 29 West 39th St., by August 10. Much such material has been already received, and it is hoped that the report as it goes to the December meeting of the society will be the embodiment of the best experience and wisdom of the nation; for besides the committee which has prepared the tentative report and the specialists who have been invited to discuss it, everybody having any interest in or ideas upon the subject is invited to present a discussion in writing and to be present if possible at the hearing.

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Duty First at Salem

On Friday afternoon, June 25, half the industrial and adjacent residential district of the historic city of Salem, Mass., was wiped out by a conflagration. Factories, churches, schools, homes, stores—poles, overhead wires, stock houses, garages and buildings to the number of about one thousand melted away in the flames which were swept back and forth through the town by the veering winds.

Near the center of the fire the generating station of the Salem Electric Lighting Co. awaited the onslaught of the conflagration. The company's offices and stock building, a stone's throw away, caught fire; the advancing wall of flames reached the opposite shore of South River, a hundred feet distant from the plant; and on the east and south, buildings and coal piles in their turn fell prey to the fire demon. In a few minutes the station was surrounded with a roaring fury of heat and leaping light; sparks flew against the walls and windows, brands struck the roof and flying oil from an exploding tank on adjacent property beat against the windows.

Inside the building, five men waited for the storm to pass. The windows were of wired glass; the walls were brick, a foot thick; the roof was of tile construction, with tar and gravel top. The distribution system was cut off, but the operating force kept steam up and ran the exciters. They played streams of water against the only two wooden doors in the building, and they saw to it that every window and door was shut to the limit of tightness. The water pressure, normally fifty pounds, was down to seven; but the boiler-feed lines were kept going. The coal conveyor belt became ignited and carried the flames into the coal pocket, but they extinguished them. In the fierce draft, sparks flew through cracks into the boiler room, the smoke from without thickened the air almost to suffocation, but the plant was manned. Gradually the heat subsided, enabling the outer air to be let in more freely, the doors were opened, and at two o'clock in the morning the United States flag rose to the top of the building amid the cheers of thousands of onlookers, who thus paid tribute to the undaunted courage of the men behind the throttle and the slice bar—men who, like thousands of others on land and sea, listened to the call of duty when it came, without retreating, and with honor to their occupation.

That this brand of courage is to be expected throughout the engineering profession and that the faithfulness of the men at the plant of the Salem company is typical may well challenge the admiration of those who take little thought of the qualities which have made the American power-station operator what he is today.

⁂

Municipal Coalition to Avoid Utility Extortion

The way to avoid an exorbitant charge for a service is to do it oneself. This applies to communities as well as to individuals.

If water, gas, electricity, transportation are not furnished satisfactorily and at reasonable rates by the present purveyors, it behooves a community to furnish them itself. The reasons why most communities do not do so are the distrust of municipal ownership, which has been created at enormous expense by those whose interest is to prevent it, and the paper walls which the same interests have erected against the communal undertaking of such enterprises.

Not so many years ago, the proposition that the rates of public-service corporations be subject to governmental regulations was decried as radical and revolutionary in the extreme—a veritable imposition upon the rights of property. Today, in nearly all the states, the activities of public-service corporations are controlled by public-service commissions, which not only fix rates but control the issue of securities and decide whether a company may or may not do business in a given locality. In some states it is necessary for a city to obtain the sanction of such a commission before its people can, in their collective capacity, perform their own public services.

The decisions of these boards seem to indicate that they have sometimes been unduly impressed by the able arguments presented by the best talent which the united interests can buy, untempered by any such adequate presentation of the people's side of the case.

There is now on foot a movement to unite the cities in an effort to procure an equally able presentation of their side of the story. Mayor Rudolph Blankenburg of Philadelphia has issued an invitation, in which he is joined by Mayors Mitchel of New York, Harrison of Chicago, Baker of Cleveland and Shroyer of Dayton, to the mayors of all cities, large and small, to meet in conference in Philadelphia, in the autumn, to discuss the various phases of the public-utility problems as affecting the people, and how they may best be dealt with.

It has been suggested that a Bureau of Public Utilities Research be organized, which shall equip itself to give to the cities the same able assistance which the public utilities companies' associations give to the public utilities companies, thus in effect constituting an offensive and defensive alliance among the cities similar to that existing among public-utility corporations.

Correspondence

Auxiliary Economy in Steam Power Plants

Mr. Starkweather's position regarding the rating of closed heaters, as published in the June 9 issue, page 827, is well taken, but if auxiliary economy is the object, why use the closed heater at all?

It is true that, with a constant of transmission of 250 deg. per sq.ft. per hour per degree difference in temperature, the water may be heated to within 5 or 7 deg. of the steam temperature. As each 10 deg. in the temperature of the feed water ordinarily represents about 1 per cent. of fuel, it might appear that only one-half or three-quarters of 1 per cent. were lost. However, if the amount of exhaust steam available is limited at times, as is usually the case, the loss in economy through the use of a closed heater may amount to 1 or 1½ per cent., because the steam condensed in heating the water in a closed heater is ordinarily wasted, whereas, in the open heater it is conserved, saving the heating of that much cold water.

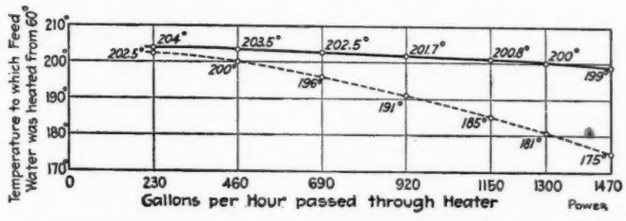


Diagram Showing Graphically the Result of Tests of a 1300-Gal. Heater Using Exhaust Steam

In one case it is estimated that at normal load there would be 178,000 lb. of feed water to be heated and that the supply of exhaust steam would vary from 18,000 to 28,000 lb., while at 50 per cent. overload, with 260,000 lb. of feed water, the supply of exhaust steam would vary from 21,000 to 31,000 lb. per hour. Under the normal load condition, with 18,000 lb. of exhaust steam available, the open heater would give a temperature of 195.5 deg. F., while the closed heater would give only 182.9 deg., a loss of about 1¼ per cent. in fuel economy. With 28,000 lb. of exhaust available, the open heater would give theoretically, and practically also if provided with proper heating trays, 212 deg., whereas the closed heater, assuming 0.7 sq.ft. per horsepower and a coefficient of 300 instead of the 250 stated by Mr. Starkweather, could, at the best, give only 210 deg.

Under the overload conditions, with 21,000 lb. of exhaust available, the open heater would give 173.1 deg., and the closed heater only 163.1 deg., while with 31,000 lb. the open heater would give 212 deg. and the closed heater only 200.3 deg.

The capacity in both cases is based on the supposition that no steam is wasted. This condition can be secured with an open heater if properly installed, and is ordinarily guaranteed by the makers. With a closed heater, on the other hand, it is difficult or impossible to secure the maximum transmission unless there is sufficient exhaust-steam surplus to keep the heater free of an accumulation of air. There is always some air in the exhaust steam, and if all the exhaust steam supplied to the heater is condensed, there will be a continual accumulation, bringing about an air-bound condition similar to that of a surface condenser operated without an air pump.

In closed heaters as ordinarily designed, this condition exists even when there is considerable surplus of steam, as shown in the accompanying diagram, giving the results of a test on a closed feed-water heater of the high-velocity type. The full line represents the higher temperatures obtained when reducing the quantity of feed water and maintaining the flow of exhaust steam at half the weight of the listed water capacity of the heater. In other words, about three times as much exhaust steam was being passed through the heater as should have sufficed to heat the feed water up to 212 deg. The dotted line gives the temperatures obtained with only 2300 lb. of steam per hour, and shows that when only the theoretical amount of steam required to heat the water is supplied, a temperature of only 175 deg. is reached.

It is true that the waste of the condensed exhaust steam could be avoided by fitting the closed heater with an oil separator, as has been done in some cases, and it also protects the tubes of the heater from grease accumulations, although it does not prevent scale, both of which frequently cause considerable loss in heat transference in such heaters. If this is done, why not omit the tubes altogether and make an open heater of it? Properly designed and installed oil separators have proved successful, and water condensed from steam purified by such separators, or heated by direct actual contact therewith, is used for ice making, dyeing, laundering, etc., where the least trace of oil would be inadmissible

Other advantages also entitle the open heater to consideration, as, for instance, its action in driving air and other gases out of solution in the water as it is sprayed through the steam bath of the heater. Recent investigations have abundantly established the fact that corrosion in boilers does not take place in the absence of dissolved air; further, where the piping, the turbine casing and the condenser are carefully erected, the air dissolved in the feed water is about the only source of air in the condenser. With absolutely air-free condensers, the problem of maintaining high vacuums would be easily solved, with almost any kind of air pump or even none at all.

The breaking up of bicarbonates by heat also brings about the precipitation of a considerable portion, which is beneficial in the case of the open heater, as the sludge settles in it instead of going to the boiler; it is detrimental, however, in the closed heater, as the formation of scale on the tubes interferes with heat transmission. The open heater is available as a return tank or hotwell for the reception of live-steam trap discharge and other water supplies about the plant suitable for boiler feeding.

and also acts as an automatic makeup water regulator, neither of which is done by the closed heater.

The open heater has been brought to such perfection and utility—as witness the use of extra-large separators for purifying the surplus exhaust steam for heating systems, cooking kettles, low-pressure turbines, drying systems, etc., and the recently introduced metering heaters, for measuring the boiler feed—that a return to the closed heater seems a step backward.

There is one place, however, where the closed heater may be used as a primary heater in the exhaust line between the engine and the condenser. This, however, is being discarded because of the extra resistance introduced, and because recent designs of condensers deliver the condensate nearly at steam temperature.

WILLIAM B. CAMPBELL.

Philadelphia, Penn.

Value of Laboratory Coal Testing

A number of POWER articles, as well as an editorial, on the value of laboratory coal testing, have interested me. Laboratory tests alone are of but little service, and purchasing coal on the B.t.u. basis alone, or the B.t.u. and ash basis, particularly by proximate analysis, is unwise because it does not give any real information as to what the coal will do when burned under the boiler.

Different types of boilers and settings will burn to the best advantage coal of only one character, each boiler and setting being adapted to a coal having certain fairly definite characteristics. It is advisable, therefore, to experiment with different coals under the boiler, and determine which one will evaporate the most water. Next, take the best sample, have it analyzed, and draw up specifications for coal which will come as close to this analysis as is possible.

Coals vary widely in moisture, volatile matter, fixed carbon and ash. For the majority of boilers as now set—i.e., too near the grates—coals which run the lowest in moisture or are high in fixed carbon are the most satisfactory.

The accompanying table is of samples of coals ranging in heat value from 14,701 to 13,825 B.t.u. The volatile matter ranges from 36.77 to 15.8 and the fixed carbon from 75.83 to 55.14; the latter, No. 10, is low in moisture, comparatively low in ash, but high in volatile matter. This coal with the ordinary low setting will not give nearly as good results in evaporation as No. 4, which has 75 per cent. fixed carbon and but 15.8 per cent. volatile matter.

Order of Value by B.t.u.	B.t.u.	Moisture	Volatile Matter	Fixed Carbon	Ash	Order of Volatile Matter
1.....	14,701	2.80	17.10	74.80	5.30	12
2.....	14,672	1.63	17.17	75.83	5.86	11
3.....	14,522	3.37	21.80	70.74	4.09	9
4.....	14,499	1.10	15.80	75.69	7.41	14
5.....	14,470	3.05	31.65	60.82	4.48	3
6.....	14,465	2.00	17.52	74.10	6.33	10
7.....	14,436	3.74	31.04	61.31	3.91	4
8.....	14,425	2.96	22.74	69.29	5.01	8
9.....	14,279	3.51	16.82	73.04	6.63	13
10.....	14,107	1.75	36.77	55.14	6.34	1
11.....	14,105	2.86	33.25	58.08	5.83	2
12.....	14,074	3.23	26.16	63.90	6.71	7
13.....	14,069	1.48	28.58	61.55	8.39	6
14.....	13,925	4.08	28.61	60.73	6.58	5

The reason is that, with the present character of setting, with grates so near the boilers and with hand firing, the volatile matter is driven off unburned, carrying with it a considerable percentage of fixed carbon in the form of smoke. Therefore, in addition to the B.t.u. test, the specification should state the minimum of fixed carbon or the maximum of volatile matter, as well as the percentage of ash and moisture. In no better way can the purchaser be assured that the coal bought will work satisfactorily.

This was plainly demonstrated in a large plant where coal was bought on a straight B.t.u. basis. The coal was sampled by an expert and carefully analyzed. In many samples the B.t.u. ran above the guarantee, and a bonus was paid, but the evaporation fell off. The owners were seriously "up against it." Fortunately, before this had gone on long, they again called in the engineer who had written the specifications. The coal dealers claimed that they were furnishing all that was called for and demanded the bonus. The engineer, however, pointed out a clause in the contract, which had been put in largely as an afterthought, covering the minimum amount of fixed carbon which would be accepted; the coal furnished had run considerably under this percentage. Thereafter a different coal was sent, which met the needs of the plant fully.

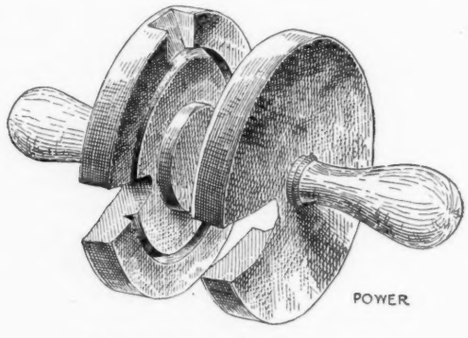
Of course, it must be remembered that coals vary in different localities in volatile matter, fixed carbon, ash and moisture, but each will burn satisfactorily with some certain type of setting. Therefore, when installing a plant, the first thing to do is to determine the character of the coal which is in that market, and then use a boiler and setting adapted to such coals. This point being covered, a specification can be drawn which will describe the coals desired, and thereafter economy is assured so far as it can be obtained through the proper purchase of coal.

HENRY D. JACKSON.

Boston, Mass.

Lead-Gasket Mold

A mold we use for forming small lead gaskets, I think, is much better than the plates described by J. C. Hawkins in POWER of April 28, p. 604. It is light and easy to handle, and one man can pour twice the number of gaskets with it that two men can with the plates. One of the handles shown is to be clamped in a vise.



MOLD FOR SMALL GASKETS

We have used them with satisfaction on Heine boilers carrying 150 pounds pressure. The gaskets are easily removed from the mold with the aid of a screwdriver.

C. L. SPURRIER.

Elyria, Ohio.

Some Data on Slack Belts

That a slack belt has decided advantages over a tight-running belt has been repeatedly stated, but data relative to the reliability and pulling power of the former have not been given.

Here are some figures taken from eight actual installations where belts are run with considerable slack. They prove that tightness is certainly not always necessary; I do not believe it is ever necessary. The trick in belt operation is to keep the belt flexible and soft so that good contact is always made with the pulleys.

Width of Belt, In.	Kind of Belt	Horsepower Transmitted	Tension on Pulling Side, per Inch of Width, Lb.
10	Canvas	85	90
12	Leather	82	92
19	Leather	90	110
14	Leather	100	113
6	Leather	25	114
20	Leather	100	117
10	Cotton	70	127
16	Painted canvas	300	264

Note, particularly, the last column on the right. These pulling tensions are much higher than is usually attained with belts that are kept tight on the nonpulling side, and, better still, these slack belts run smoothly, giving no trouble whatever; they pull peak loads with ease.

The looser the belt, the greater is its arc of contact, and therein lies one of the greatest advantages. These data are a direct contradiction to the declarations made by many that "belts well proportioned for the work required of them need tightening at intervals of two to six months."

S. F. Wilson.

New York City.

Electrifying Furnace Air

In the June 16 issue, A. P. Conner suggests that in cases where mechanical draft is used, a much greater efficiency could be obtained by electrifying the air before it goes to the blower. He states that this would cause the air to become ozone, which, in contact with the fire, would combine much more energetically than ordinary air. It may be interesting to learn more about this little-understood ozone.

Ozone was first noticed by Van Marum, in 1785, as a peculiar smelling gas formed during an electric discharge. Schoenbein named the gas and noted its powerful oxidizing properties. Ozone is a modification of the element oxygen.

The smallest particle (molecule) of ordinary oxygen capable of existing alone consists of two oxygen atoms, while the molecule of ozone has three. As the oxygen atoms in ozone are not as firmly held together as those in ordinary oxygen, ozone is readily broken up or decomposed by many substances. In the presence of moisture nearly all metals except gold and platinum decompose ozone, and are themselves oxidized or corroded. Ozone is *partially* decomposed into ordinary oxygen at room temperature and *completely* decomposed if heated to about 570 deg. F. Ozone has other interesting properties: It is blue in color; has an odor somewhat resembling that of bleaching powder, and one part in 500,000 parts of air can be detected; it acts on the respiratory organs, making breathing difficult, and small animals die quickly when they breath it.

The use of ozone for improving furnace combustion seems more fanciful than practical. Even assuming that any of the "ozonizers" on the market are capable of cheaply and completely changing the oxygen of the air to ozone, it is very doubtful whether any ozone as such would ever reach the furnace fires. Unless all the moisture in the air was eliminated, the ozone in the presence of moisture would have a corroding action upon nearly all metals with which it came in contact, and would itself be decomposed.

Since ozone is completely broken up at about 570 deg. F., which is well below combustion temperatures, it is obvious that before it reached the fire it would be transformed into ordinary oxygen and the electrical energy which had been consumed in its production would have been wasted.

William A. Dunkley.

Atlantic City, N. J.

Baffling Water-Tube Boilers

In the May 19 issue, in the article on "Baffling Water-Tube Boilers," the information contained is valuable, but it might be misleading from the fact that it applies to natural or induced-draft installations only. The areas given therein will not prove successful from an efficiency or capacity standpoint on forced draft, being especially inefficient on overload capacities.

That the same areas will not apply to forced draft can be determined mathematically as well as by actual test. Consider, for instance, the release areas on the Stirling boiler. Other conditions being equal, the ratio between any pair of release areas would be determined by a compound proportion, the first terms of which are the ratio at corresponding points of vacuum or draft measured by water gage and the ratio of the volume of gases at the same points due to difference in temperature.

It may be assumed for all practical purposes that the latter ratio is the same in both natural- and forced-draft installations, so that the area of release openings may be considered inversely proportional to the water gage at or near the release areas. If the vacuum or draft at each release of a Stirling boiler beginning at the release nearest the stack is represented by the letters V_1, V_2 and V_3 and the vacuum over the fire by V_4; and the corresponding release areas as R_1, R_2 and R_3, the following proportion will be obtained:

$$V_1 : V_3 : : R_3 : R_1$$

In forced draft V_4 can be considered zero, as in modern forced-draft plants it is held down to from 0 to 0.05 in. In natural-draft plants the stack pull must be sufficient to overcome the fuel-bed resistance and V_4 becomes, say, 0.25 in. The vacuum at the three releases would then be: $V_1 + 0.25$ in., $V_2 + 0.25$ in., and $V_3 + 0.25$ in. The proportion for the release area would be,

$$V_1 + 0.25 : V_3 + 0.25 : : R'_3 : R'_1$$

It is evident that the addition of a constant to each term of a ratio changes the ratio, and, therefore, the ratios of the release areas in natural draft are not the same as in forced draft. The addition of a constant also decreases the fourth term of the proportion, which also demonstrates that the release areas nearest the stack on forced draft should be reduced and that the passes nearest the grates should be increased, over the usual practice with natural draft.

This result has been demonstrated in practice many times and the release areas that prove successful by ex-

periment with natural draft are unsuccessful with forced draft. Anyone installing or using forced draft and endeavoring to get results by using ratios of openings given in the article mentioned would have serious difficulty.

J. H. DIETZ.

Cleveland, Ohio.

[In this article Mr. Monnett referred to natural draft only. What he has to say concerning forced and induced draft will appear later in the series.—EDITOR.]

Blowoff Pipe Failures

The suggestion given by Basil Copping, on page 786, June 2, about the cause of the blowoff fracture does not look good to me. No doubt, opening the cocks disturbed the scale slightly, or that when closed the scale blockade gave away suddenly and was forced into the practically empty pipe along with water. It is simply a case of water-hammer.

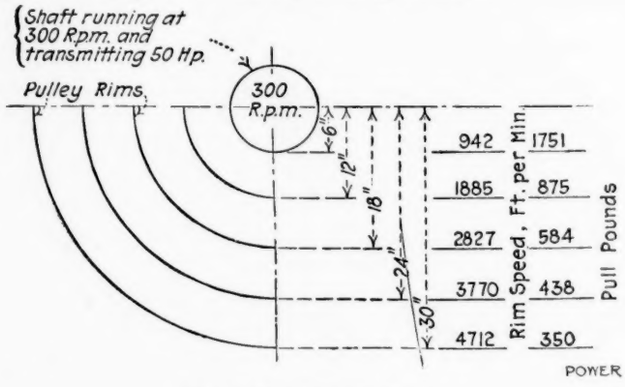
An interesting blowoff break occurred here on June 7 during a heavy rain storm, with a lot of lightning and thunder thrown in. Several people noticed what looked like a ball of fire break and scatter right over our smoke-stack; at the same instant the blowoff pipe on one of the boilers gave way. There was 70 lb. pressure on the boiler at the time and it made things lively; steam and cinders were blown about the boiler room. The blowoff pipe was later examined and found to be bent and twisted. The end, which was outside of the boiler setting and not in contact with fire or heat, was fused and twisted badly, it was also red, as if it had been hot and part of the end was fused. Nothing else was damaged. The boiler inspector and I agree that it was caused by the lightning, but why it should come down the chimney, strike the blowoff pipe and touch nothing else, beats me.

JOHN THORN.

Toronto, Ont., Canada.

Belt Pull on Bearings

A point that is frequently overlooked when selecting pulleys is that the larger the pulley, the less will be the pull on the bearing and belt in transmitting a given power, the speed of the shaft being constant.



BELT SPEED AND PULL

For example, a 12-in. pulley transmitting 50 hp. at 300 r.p.m., the belt speed would be about 943 ft. per min., and the pull (assuming zero tension on the slack side) 1750 lb. With a 24-in. pulley the speed would be 1886 ft. per min., and the pull 875 lb., and so on, as shown in the diagram. It is best not to use either extreme because, where the diameter is small the pull is too great, and where the diameter is excessive, the velocity is too great.

W. F. SCHAPHORST.

New York City.

Oil Explosion in an Air Compressor

I fed a lot of oil into a two-stage, tandem air compressor to be sure I would get enough into the cylinder, but I used too much, and it exploded in the high-pressure air cylinder. No damage was done to the air compressor, but the high-pressure air line ruptured in five different places. Small pieces of copper pipe were found all over the building and some went through the roof. Fortunately, no one was injured.

JOHN J. OELRICH.

Amadoville, Ariz

Commutator Insulation

Pitting of the mica insulation between segments of commutators leads to all sorts of trouble. The better the insulating material, the less the danger of pitting, although the best will pit to some extent. This results in a flash-over, burned-out coil or other commutator trouble.

To overcome this, I use a paste made up of powdered mica, plaster of paris and orange shellac mixed together in the form of an easily workable mixture. To apply, first clean out all the burned insulation and scrape until the mica can be seen; then press the paste into all the crevices thoroughly without entrapping air. Allow the work to stand for a short time, and then scrape with sandpaper until the commutator is smooth, and the machine is ready.

The drier this paste, the better the insulation. Therefore, to be sure of a good job, bake or heat it with a torch until dry. It will keep a motor or generator running as long as there are no burned-out wires, and will often save coils from being burned out. The best tool for cleaning out the burned mica is had by grinding a hacksaw blade to about the thickness of the insulation.

I have tried this for years and have found it to give good satisfaction.

F. A. GROHSMEYER.

Chicago, Ill.

Frost Covered Generator

In answer to E. R. Pearce's letter in the June 9 issue, I do not believe that the insulation was affected. There is always a little moisture in the engine-room coming from the crank cases of two Westinghouse engines, and this collects in the generator casing as soon as the temperature goes below freezing.

The handhole plates were taken off and no moisture or frost could be found inside, while the coils were of a higher temperature than the casing. As the load increased to one-half or better, the frost started to melt off. The field excitation, so far as could be ascertained, was not impaired and is usually better in cold weather than in summer.

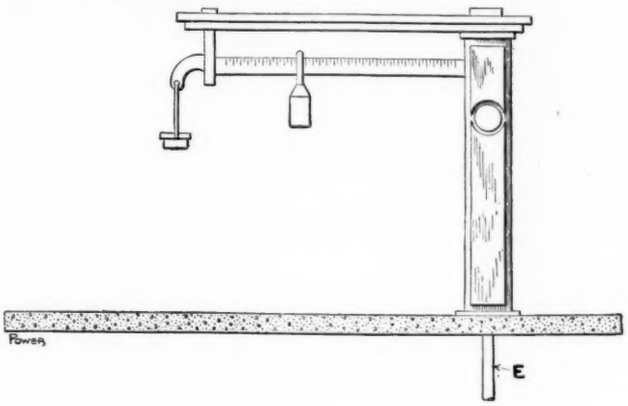
F. E. ALBRECHT.

Lisbon, Ohio.

Scale Beam in the Engine Room

That the coal record of many of our smaller plants is not accurately kept is due to not having the proper weighing facilities.

The idea shown here comes from one of our engine rooms. The scale beam can be placed in the engine room,



Scale Beam in Better Location

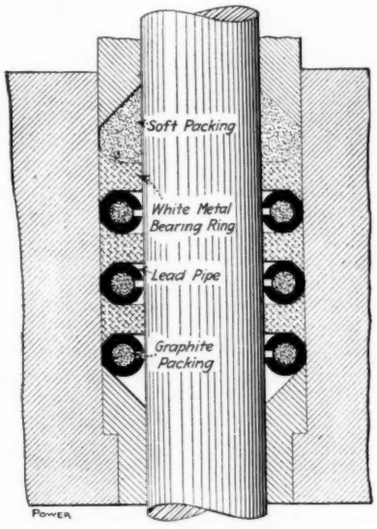
where the chief or the engineer in charge can read and record the weight of the coal as it is delivered. The scale beam can thus be kept in a better condition, and the engineer does not have to leave his post to ascertain the correct weight. Many of our plants could be thus equipped by simply lengthening the link rod *E*.

C. R. McGahey.

Baltimore, Md.

Rod Packing

The illustration shows a section of an easily made packing which will be found serviceable for the steam ends of direct-acting pumps and compressors. It has



Metallic Packing

two parts—i.e., heavy lead-pipe rings and bearing rings which also act as wedge blocks. The lead pipe is cut a little shorter than the circumference of the rod, then one end is plugged with a disk of lead and soldered up, and the tube rammed tight with powdered graphite, which has had enough cylinder oil added to make it plastic.

When the ring is full a disk is soldered into the other end or the end beaded over the disk (the presence of oil makes soldering difficult). A number of ⅛-in. holes are drilled on the rod side of the packing at about ¾-in. centers so that the lubricant will come out on the rod.

The bearing rings must be in halves and may be left rough on the sides, the edges being fitted to the rod and stuffing-box, where it will give the rod a little support. The best mixture for the rings is composed of 75 parts lead, 5 parts tin and 20 parts antimony, but pure lead may be used with success. At the outer end of the gland a turn of ordinary soft packing is put in.

It is also advisable to drill a few holes in the bearing rings to enable them to be drawn out with an ordinary packing hook. This packing is suitable for any saturated steam pressure in ordinary use and for low superheats so long as the total temperature does not exceed 475 deg. F.

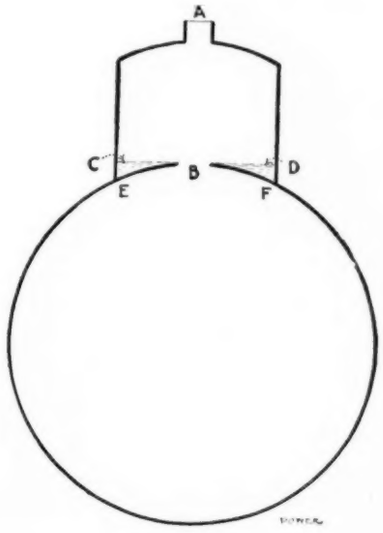
The sketch shows the packings in place before screwing up the gland, after which, of course, they are distorted.

E. R. Pearce

Rochdale, England.

Water Lodged in Boiler Dome

A boiler having a dome mounted as shown in the sketch had a 4-in. outlet at *A*. A 6-in. hole was cut in the boiler shell at *B* to allow the steam to enter the dome. When the boiler was under pressure, and was not in use, a cracking noise in the dome could be heard. The steam



Where the Water Lodged

would be very wet when the valve was first turned on.

After the boiler cooled down, pockets of water were found at the points *C* and *D* in the dome. To drain these pockets, holes were drilled at the points *E* and *F*, and the trouble stopped. Evidently the heat in the steam failed to evaporate the water in the dome.

Charles G. Buder.

St. Louis, Mo.

Engineers' Study Course

Elementary Mechanics--XVII

Last Lesson's Answers

71. The length of the crank OA (Fig. 62) is 6 in. In one revolution of the engine the crankpin A will move a distance equal to

$$2 \times 3.1416 \times 6 = 37.7 \text{ in.} = 3.14 \text{ ft.}$$

The velocity of the crankpin in feet per minute equals

$$300 \times 3.14 = 942 \text{ ft.}$$

Let the line AC drawn at right angles to the line OA, represent this velocity. Extend the line of the connecting-rod BA and from C drop the perpendicular CM to AB. Then the line AM will give the velocity with which the connecting-rod is moving at the given instant and, since the rod is assumed rigid, the velocity of B (which represents the crosshead) must equal the velocity AM of the point A. The velocity of the crosshead is the horizontal component of the velocity of the connecting-rod. Therefore, draw the line AN horizontal, and from M drop the perpendicular MN to the line AN.. The numerical value of the velocity AN may be found as follows:

$$\sin a = \frac{AD}{AB}$$

and

$$AD = OA \times \sin 45 \text{ deg.} = 6 \times 0.707 = 4.24 \text{ in.}$$

or

$$\sin a = \frac{4.24}{30} = 0.14$$

hence angle $a = 8$ deg. (approx.). By construction the angle CAN = (angle a + angle x) = 45 deg. Now, since the angle a equals 8 deg. it must be evident that the angle x equals $(45 - 8) = 37$ deg.

But

$$AM = AC \times \cos 37 \text{ deg.} = 942 \times 0.799 = 752$$

and

$$AN = AM \times \cos 8 \text{ deg.} = 752 \times 0.99 = 745$$

Therefore, the velocity of the crosshead at the given instant is 745 ft. per min.

This problem is inserted to illustrate the fact that it is possible for a single velocity to have a number of components acting in any number of directions. As a general rule the velocity of the crosshead will be determined graphically as shown in Fig. 62 instead of being figured numerically as has been done in this problem.

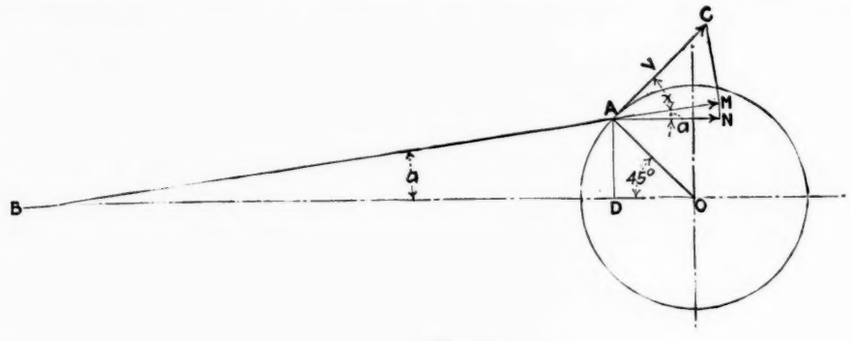


Fig. 62.

72. The resultant of the velocity with which the man is rowing the boat and the velocity of the stream must be a horizontal velocity if the boat is to land at a point directly opposite its starting point. In Fig. 63, let OA represent this resultant velocity, OB the direction the man has to head the boat and OC the direction of the current of the stream. From the conditions of the problem, OB equals six miles per hour and OC equals two miles per hour; hence

$$\sin x = \frac{AB}{OB} = \frac{2}{6} = 0.333, \text{ or } x = 19\tfrac{1}{2} \text{ deg.}$$

73. The velocity with which he is crossing the stream is given by the line OA (Fig. 63) which is equal to

$$OB \times \cos x = 6 \times 0.943 = 5.66 \text{ miles per hour} = 498 \text{ ft. per min.}$$

74. Time equals space divided by the average velocity.

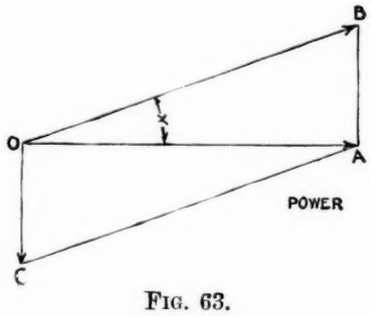


Fig. 63.

Or

$$\text{time} = \frac{1000}{496} = 2 \text{ min. (approx.)}$$

75. The desired velocity may be found by substituting the given velocities in equation (29). Thus $V_1 = 50$ ft. per min., $V_2 = 75$ ft. per min. and $V_3 = 200$ ft. per min. Hence, letting X equal the velocity of the load relative to the ground, there results,

$$X = \sqrt{50^2 + 75^2 + 200^2} = \sqrt{48{,}125} = 219+ \text{ ft. per min.}$$

Uniform and Accelerated Motion

Acceleration is the rate at which the velocity of a body changes and is expressed in the number of feet per second the velocity changes for every second the body is in motion. This acceleration may be *uniform* or *variable;* if uniform the velocity will increase at a uniform rate. *The formulas which are derived in this lesson apply only to problems involving uniformly accelerated motion.*

A body starting from rest and moving with an acceleration of a ft. per sec., at the end of T sec. will have acquired a velocity of aT ft. per sec. Let V = this velocity. Then

$$V = a \times T \qquad (30)$$

The average velocity during the time the body is in motion will be the sum of the final and initial velocities divided by two or

$$\left(\frac{0+V}{2}\right)=\left(\frac{0+aT}{2}\right)=\frac{aT}{2}$$

The space S passed over by the body will equal the average velocity multiplied by the time, or

$$\frac{aT}{2}\times T=\tfrac{1}{2}aT^2$$

hence,

$$S=\tfrac{1}{2}aT^2 \qquad (31)$$

Also, from equation (30),

$$T=\frac{V}{a}$$

Substituting this value for T in equation (31), thus

$$S=\tfrac{1}{2}a\times\left(\frac{V}{a}\right)^2=\frac{V^2}{2a}$$

or

$$V^2=2aS \qquad (32)$$

and

$$a=\frac{V^2}{2S} \qquad (33)$$

Therefore, when a body starts from rest the acceleration may be found if the final velocity and the space passed over are known. Equation (33), it will be noted, is *independent of the time.*

Illustration: A train starts from rest and after it has passed over a distance of 1000 ft. attains a speed of 22 ft. per sec. What is its acceleration?

From equation (33) $a=\frac{V^2}{2S}$, where V = the final velocity in feet per second, and S is the distance passed over during the attaining of the given velocity,

$$a=\frac{22\times 22}{2\times 1000}=0.24\ \textit{ft. per sec. per sec.}$$

In certain problems it may be desirable to express the acceleration in some other units as miles per hour per second, or miles per hour per hour.

If the body has an initial velocity of U feet per second before the increase in velocity takes place the formulas just stated will be somewhat modified. Thus, let U = the initial velocity of the body in feet per second. Then if the body moved with a uniform velocity only, for T sec. the space passed over would be UT ft. Now, if *in addition to the uniform velocity* the speed is being accelerated, then the space passed over during the time of the acceleration will be $\frac{1}{2}aT^2$, as shown in equation (31), to which must be added the space passed over due to the uniform velocity of U ft. per sec. Therefore, the total space passed over by a body moving with an initial velocity of U ft. per sec. which is accelerated at the rate of a ft. per sec. for a period of T sec., will be given by the equation,

$$S=UT+\tfrac{1}{2}aT^2 \qquad (34)$$

The final velocity of the body at the end of the period of acceleration will equal the sum of the initial velocity U, plus the gain in velocity, which, from equation (30), is aT. Let V_1 = the final velocity, then,

$$V_1=U+aT \qquad (35)$$

Example: A train is running at 15 miles per hour (22 ft. per sec.). The engineer turns on more steam so as to give an acceleration of 0.75 ft. per sec. per sec. (*a*) What is the velocity of the train at the end of 8 sec.?

From equation (35), $V_1=U+aT$, where $U=22$ ft. per sec., $a=0.75$ ft. per sec. and $T=8$ sec.; hence,

$$V_1=22+0.75\times 8=28\ \textit{ft. per sec.}$$

(*b*). How far did the train move while the gain in speed took place? From equation (34), $S=UT+\frac{1}{2}aT^2$ where $U=22$ ft. per sec., $T=8$ sec. and $a=0.75$ ft. per sec.; hence,

$$S=22\times 8+\tfrac{1}{2}\times 0.75\times 8^2=200\ \textit{ft.}$$

The average velocity during the time the body is in motion is $\frac{U+V_1}{2}$ and the space passed over in T sec. is S, whose value is

$$S=\left(\frac{U+V_1}{2}\right)\times T \qquad (36)$$

From equation (35), $T=\left(\frac{V_1-U}{a}\right)$. Substitute this value of T in equation (36) and there results,

$$S=\frac{(U+V_1)}{2}\times\frac{(V_1-U)}{a}=\frac{V_1^2-U^2}{2a}$$

or

$$V_1^2-U^2=2aS \qquad (37)$$

Equation (37) may be used to check the results of the above problem, thus the final velocity V_1 of the train was found to be 28 ft. per sec. and the initial velocity was 22 ft. per sec. and the acceleration 0.75 ft. per sec. Substitute these values in equation (37) and there results,

$$28^2-22^2=2\times 0.75\times S$$

or

$$S=\frac{28^2-22^2}{2\times 0.75}=\frac{784-484}{1.5}=\frac{300}{1.5}=200\ \textit{ft.}$$

If the velocity of a body is being decreased there will take place a deceleration or retardation in place of an acceleration and the value of a will become *negative* instead of *positive.* The formulas for retarded motion will be as follows:

$$S=UT-\tfrac{1}{2}aT^2 \qquad (38)$$

$$V_1=U-aT \qquad (39)$$

$$V_1^2=U^2-2aS \qquad (40)$$

Study Questions

76. A subway train starting from rest attains a speed of 30 miles per hour (44 ft. per sec.) in a distance of 800 ft. What is the acceleration in feet per second per second?

77. The velocity of a moving body changes from 66 to 22 ft. per sec. while the body moves through a distance of 1000 ft., what is the retardation?

78. Express an acceleration of 2 ft. per sec. per sec. in miles per hour per second; in miles per hour per hour.

79. A train is traveling at 60 miles per hour (88 ft. per sec.). The engineer applies the brakes and at the end of 20 sec. the speed is reduced to 15 miles per hour (22 ft. per sec.). Find the deceleration.

80. How far did the train travel during the application of the brakes?

Efficiency Experts Take Notice—From figures quoted in the "Electrical World" it appears that London's electrical supply is furnished by no less than 65 separate installations, both private and municipal. These comprise 31 different systems of generation, 21 distributing voltages, eight different frequencies, and, to make the situation more confusing, there are 50 methods of charging for the output.

OVER THE SPILLWAY

JUST JESTS, JABS, JOSHES AND JUMBLES

THE ENGINEER

(As seen by the office boy)

By R. T. STROHM

The engineer? Oh, he's the gink
They cuss when lights go on the blink.
You'd think that any fool would know
Enough to make an engine go.
Sometimes I'm sure it balks and stalls
Because it hates his overalls—
You know, the blue kind worn by rubes
And harvest hands and other boobs.

The engineer? Oh, he's the dub
That every morning has to scrub
The tarnish off the copper signs
And polish each until it shines.
And maybe once or twice a week
They call him in to fix a leak.
But say! I'd know what loafing is
If I'd a lead-pipe cinch like his!

The engineer? Oh, he's the bo
That keeps the sidewalk clear of snow,
And fixes locks, and glazes doors,
And varnishes the office floors.
His work's not half as hard to do
As that which falls to me or you;
Yet yesterday he had the cheek
To ask for sixteen bones a week.

The engineer? Oh, he's the chap,
With grease and coal-dust on his map,
Who spends his time in cutting rings
To put in pipes and pumps and things.
Sometimes he carts a load of coal
And heaves it through the fire-hole;
But say! if I'd a snap like that,
The rest I'd get would make me fat!

You'd never believe that tempus fugits if you could have glimpsed the Stevens Institute 100 per cent. bunch the other night. No Geyer crowd of Coster mongers ever get together than old '77 at its annual fiesta. Pearce and Roberts made home runs by proxy. And on the brink stood Brinckerhoff! John Rapelje is the only boy whose headpiece needs no mortarboard to save his scalp from sunburn, and it takes Idell to bring up the Van. As usual, Nash metered out the water at the Engineers Club, and Uehling got a CO_2 record of the cider. Whurroo! Vive! and Gesundheit ad libitum!

Charles O. Sandstrom, Kansas City, Mo., wins the prize in the Why-I-Work-in-a-Power-Plant contest. Clifford Danner, Lacombe, Alta., Canada, has honorable mention.

Mr. Sandstrom's answer is as follows:

Editor of the Spillway:

"Why do I work in a Power Plant?" Well, I might say, "Because I love Horticulture," but I won't. It is because—

I love the beteunits, that scamper through the main; and the amperevolts so frisky, though they sometimes give me pain: but I do detest a high C, oh! no matter how 'tis had; while I can stand just one low C, oh! two is very bad. I love the lushuscurrents, from the dinamosogrand; and the cleverlittlentropy does surely beat the band: but I do dislike a blounoutube, no matter how 'tis got; and a pesky, leekeeblowoff would make me kill a watt.

And here is Mr. Danner's reply:

Editor of the Spillway: I work in a power plant because the work appeals to me. It affords an outlet for my natural abilities, and thus makes life better. It is an honest and upright work, and while affording me congenial work, I am enabled to do others a good service. And it is the means whereby I can make a good living.

The replies came from Canada and Texas, from California and along the coast—from every state. We are proud of these letters, their humor, their optimism and, above all, their evident pride and high respect for the vocation of the operating engineer. Now and again, we have tried to inject a serious thought in this column—and this time we surely hit the mark. It's fine!

N. A. S. E. Milwaukee Program

From all indications, the thirty-second annual convention of the National Association of Stationary Engineers, to be held in Milwaukee, Sept. 7 to 12, will be a decided success. Headquarters will be at the Hotel Wisconsin. The convention will be held in the Auditorium, with its seven halls and unsurpassed facilities for large gatherings. The business sessions and the exhibit will therefore be under one roof, and the location is central to the business and hotel district.

Milwaukee is an ideal convention city. Its parks and summer resorts are numerous and its varied manufacture of power-plant equipment and supplies should prove of no little interest. The following program is an outline of what the local committee has prepared for the great annual event:

MONDAY, SEPT. 7

9 a.m. to 9 p.m.—Reception of delegates and visitors at the trains; escorted to the hotel by the band. Registration of delegates and visitors and distribution of badges at Auditorium.

8 p.m.—Official opening of exhibits in the exposition hall. John A. Wickert, chairman of the local convention committee, presiding. An address by Homer Whelpley, president of the National Exhibitors Association. Response by the national vice-president, Frederic L. Ray. Official opening by James R. Coe, national president.

TUESDAY, SEPT. 8

10 a.m.—Opening exercises at the convention hall, John A. Wickert, chairman of the local convention committee, presiding.

Invocation, Rev. W. T. Dorward.

Address, Welcome to Wisconsin, by Hon. F. F. McGovern, governor.

Response by National President James R. Coe.

Address, Welcome to Milwaukee, by Hon. Gerhard Bading, mayor.

Response by National Vice-President Frederic L. Ray.

Address by J. P. Keenan, secretary of the Citizens Business League.

Response by Past-President John F. McGrath.

Opening of the convention by National President James R. Coe.

Appointment of convention committee.

Official photograph immediately after adjournment. Recess.

2 p.m.—Session of the convention in Juneau Hall, Auditorium, where all sessions of the convention will be held. The usual order of business will be followed, including reports from the various officers and committees and a meeting of the life and accident department.

LADIES' AUXILIARY

The opening exercises of the Ladies' National Auxiliary Convention will be held in the ball room, second floor of the Hotel Wisconsin; Mrs. Rose J. Tellier, chairlady of the Ladies' Auxiliary Committee, presiding.

Invocation by Rev. W. T. Dorward.

Address, Welcome to Milwaukee, by Hon. Gerhard Bading, mayor.

Response by Ollie L. Heckler, past president.

Opening of the Ladies National Auxiliary convention by the national president, Mrs. Sophie Whelan.

Appointment of convention committees. Tea and musical in reception room of Hotel Wisconsin.

3:30 p.m.—A trip to one of Milwaukee's famous institutions.

8:30 p.m.—Prize card party for the ladies in Kilbourn Hall, Auditorium.

10 p.m.—Smoker under the auspices of the exhibitors in Juneau Hall, Auditorium.

WEDNESDAY, SEPT. 9

9 a.m.—Session of convention.

9:30 a.m.—Session of ladies auxiliary convention in the ball room of the Hotel Wisconsin where all the sessions will be held.

12 noon—Street cars to the engine builders; luncheon at the Allis-Chalmers Co.'s works at noon.

8 p.m.—Band concert in the exhibition hall, Auditorium.

THURSDAY, SEPT. 10

9 a.m.—Session of the convention.

9:30 a.m.—Session of Ladies Auxiliary.

11:30 a.m.—Annual memorial service will be held (quartettes).

2 p.m.—Athletic events including annual baseball game between the engineers and the exhibitors.

9:30 a.m.—Session of the Ladies Auxiliary.

Ladies' day at the exposition hall; souvenirs given on this day only.

8:30 p.m.—Vaudevilie show by exhibitors in Plankinton Hall, Auditorium.

FRIDAY, SEPT. 11

9 a.m.—Session of the convention. Reports of the convention committees; discussion and action on same; unfinished business; selection of 1915 convention city; election of officers.

9:30 a.m.—Session of Ladies Auxiliary.

8:30 p.m.—Installation of officers and presentations. Grand ball and cotillion conducted by H. T. McConnell, at Engleman's Hall, Auditorium.

SATURDAY, SEPT. 12

Delegates and visitors will be escorted to places of interest.

On Sept. 6 and 7 the Wisconsin State convention will be held, the opening exercises taking place on Sunday and on Monday the business sessions.

Heavy Oil Engines in Small Units

At the annual convention of the National Gas Engine Association in Chicago on June 25, H. F. Shepherd, engineer of the Bessemer Gas Engine Co., read a paper on the small oil engine. His remarks in abstract appear in the following:

It is reasonable to expect that the history of the small oil engine will parallel that of the small steam and gas engine. The late Dr. Diesel taught how to build the most efficient prime mover from thermal considerations, and his work for the building of large engines has met world-wide appreciation. The mechanism of these engines, although it may be sturdy as built for heavy units, becomes delicate when an attempt is made to design small sizes, and it will be understood that, notwithstanding the good returns from recent land and marine installations, the type does not accord with the adverse conditions of intermittent and unskilled care and improvised erection under which small units must operate.

Careful study of tendencies both here and abroad seems to indicate that the future small oil engine, up to 100 hp., will be of the hot-bulb type, and judging from the many designs emanating from old and established forms, the two-stroke-cycle hot-bulb engine is receiving special favor. Although this motor is distinctly an American product and no longer novel here, Denmark and Sweden have done some wonderful work along these lines in the past three years. In Denmark, especially, where engine builders have entered their products for test at various trials during this period, the two-stroke-cycle models have been steadily gaining points and the number of entries of four-stroke-cycle hot-bulb engines has diminished.

Building oil engines has been of necessity an extensive business in England for many years, most of the models produced having been of the four-stroke-cycle, low-compression type, using internal or external vaporizers. The attitude of the English technical press toward the newcomer during 1912 displayed doubt in spite of growing production, and builders were censured for so called extravagant claims, but interest was shown and many new designs were described. Not until 1913 did this engine really come into its own in that country as a prime mover of real technical interest, for in that year competitive trials on the Continent were published widely and many engineers representing the owners of these engines came forward to champion the cause. Most interesting was the editorial in "Internal Combustion Engineering" (London) at the close of the year, reading in part as follows:

It can be asserted without fear of contradiction that the greatest feature of internal-combustion engineering during 1913 was the wide extension of patronage accorded to the hot-bulb engine. Not only have many new manufacturers been convinced of the merits and advantages of this type of motor, but there has been a world-wide demand for it. The reasons for this great and growing popularity are not difficult to see. Primarily, this type scores by its economy, but of far greater benefit is its reliability with many different sorts of fuels. Although it is now being manufactured with an output extending to nearly 100 hp. per cylinder, its greatest application is found in moderate powers where it is rapidly replacing the older form of paraffin engine, which at one time held the market to itself. It is inevitable that not every example of the type should attain the high level of excellence which has been set by leading productions and regret must be expressed that certain manufacturers have obtained neither reliable nor economical results.

It would seem that the features of the two-stroke-cycle construction upon which critics have spoken tend to improve the combustion of the injection type of hot-bulb engine. It is often stated that, due to the alleged low volumetric efficiency of the charging arrangements of engines not employing scavenging pumps of greater displacement than the cylinders, imperfect combustion will result due to imperfect scavenging. In the light of present-day knowledge, it is known that, within certain limits, the presence of neutral gases results only in the necessity of designing for somewhat lower mean effective pressure, and while a reduction of mean effective pressure would have some disadvantage for four-stroke-cycle construction, it does not put the two-stroke-cycle motor out of the running for the reason that every revolution gives a power stroke per cylinder and the motor can still be kept well within the usual weight limits. The mean effective pressure upon which these engines are usually rated is not the maximum possible, but that at which the greatest economy of fuel is attained. A well designed engine like the Diesel will carry overloads up to 50 per cent., although the combustion, due to the small excess of air present, will not be all that would be desired.

The admixture of the fresh charge with the high-temperature neutrals left behind, together with the heat absorbed during the scavenging process, will result in an initial temperature before compression considerably higher than the atmospheric temperature. In view of this, data can be offered which would go to prove the temperature, before the explosion at full load, to be never less than 850 deg. F., with but 180 lb. compression resulting in a high final temperature, approximating Diesel temperatures after combustion and a consequent good consumption of residues. To reduce the necessary compression it has been proposed repeatedly to preheat the air charge of the four-stroke-cycle Diesel engine. Naturally, the proposal has not found favor because of the increased cylinder size necessitated.

The practice of feeding water with the air charge has been criticized as resulting in a large thermal loss due to the latent heat of the water lost in the exhaust. Still, it is known that, because of some chemical or physical action, as yet under debate, the water feed results in better combustion. There is ample proof that, with a proper rate of feed, the water is completely vaporized by contact with the piston, cylinder walls and exhaust gases before the beginning of the compression stroke, and is carried as superheated steam through the cycle. What effect is exercised over temperatures occurs through a change in the initial temperature before compression only. The latent heat lost is that which would be lost to the jackets and exhaust normally, the actual jacket loss, when internal water injection is employed, falling as low as 3½ per cent. and seldom exceeding 10 per cent. in comparison with the usual jacket loss of other types, which varies from 20 to 30 per cent. Mechanically, the extraction of the heat directly from the piston itself and from the interior of the cylinder walls has greater advantages in the way of permitting good lubrication and of reducing expansion stresses in the castings.

As to the fuel range of these engines, it might be said that short of California and Mexican crudes or residuals testing high in coke, it embraces practically all petroleum fuels offered for engine use that are heavier than the naphthas, such as many crudes, residuals and fuel oils, all gas oils, distillates and kerosenes. Further, it is found that the base of the fuel is not of the least importance, there being no tendency to form carbon as long as the coke residue is within the 4 per cent. limit usually prescribed for Diesel-engine fuels. If the engine is given the necessary attention, fuels showing coke up to 9 per cent. may be used with good results.

The full load fuel economy will vary with the size, running from 0.6 lb. per brake-horsepower-hour for large engines, to 0.85 lb. for the smaller sizes. The economy varies but little for a wide range of fuels and is approximately the same from three-fourths to full load, and less than 15 per cent. more fuel per unit is required at half load.

For driving generators the speed possibilities of the two-stroke cycle, high-compression type of engine are favorable. Because there is compression at every revolution to cushion the parts over the in-center, any lost motion in the bearings is harmless as the reciprocating parts never leave their journals, there being no reversal of pressure and no stress on the connecting-rod bolts.

Considerable criticism has been directed against the two-stroke-cycle engine as crank-case compression has caused various ills, but by the use of a crosshead and a closed cylinder end, such troubles are avoided and the life of the engine increased.

To Fight Municipal Utility Corporations

A coalition of the cities of the country, big and little, has been formed to fight the combination of municipal utility corporations, big and little, that has for a generation operated to thwart municipal progress and growth.

Leading the movement are the mayors of Philadelphia, Chicago and New York. The mayors of these three largest American cities are interested in seeing that rates and service for public utilities shall hereafter be based on the actual value used and useful for such purposes, and not on the power of a monopoly to extort what rates it will; and not on a capitalization that represents merely the selling power of utility promoters. The organization has already been started and a conference called to discuss the vital factors in these problems.

PERSONALS

J. C. Stout has recently succeeded J. M. Chapman as manager of the Cleveland, Ohio, office of the Crandall Packing Co.

Dudley A. Johnson has succeeded the late Sam Mayer as Chicago branch manager of the Joseph Dixon Crucible Co. He was formerly Mr. Mayer's assistant in that office.

Edward Holden, for a number of years connected with the heating and ventilating firm of Evans, Almirall & Co., New York City, has resigned his position.

Harry F. Bower, vacuum-heating expert with Warren Webster & Co., Camden, N. J., for twenty-three years, has resigned his position as manager of that company's Boston office.

G. A. Reichard, of the Los Angeles office of the International Steam Pump Co. will sail from San Francisco, July 11, on the Pacific Mail Steamship "Manchuria" on a four months' business trip to Japan, China and the Philippines.

Harry J. Marks, manager of the New York office of the American Engine & Electric Co., has been advanced to the position of sales manager of the company. He will divide his time between the New York office, 90 West St., and the main office of the company, at Bound Brook, N. J.

John H. Adams has been appointed engineer in the power department of the West Penn Traction Co., Pittsburgh, Penn. He began work at 16 in the motor-winding department of the Augusta (Ga.) Ry., and worked through the car shops, power stations, overhead-line department, maintenance-of-way department, etc. He was made chief engineer and assistant to the general manager at the time the late Edward H. Harriman purchased the property at Augusta in 1908 and continued in this capacity until J. G. White & Co., New York, took over the operation, when he was made engineer of maintenance-of-way and superintendent of motive power. Mr. Adams resigned from this last position to become connected with the West Penn Traction Co.

OBITUARY

HARRY F. FEY

On June 2 Harry J. Fey was taken suddenly ill, and died in the Johns Hopkins Hospital, at Baltimore, Md., on June 6. For the past three years Mr. Fey was in the employ of the Dearborn Chemical Co. He had a wide circle of friends and business acquaintances who will sincerely regret his sudden death.

NEW EQUIPMENT

ATLANTIC COAST STATES

The Bates Mfg. Co., Lewiston, Maine, is building a new boiler house, 59x165 ft. New equipment will be needed.

A power plant, according to press reports, will be built on Deer Island, Boston, Mass., to furnish power to operate the plants on the island.

SOUTHERN STATES

On June 16, fire destroyed the South Boston Electric Light & Power Plant, South Boston, Va.

The Hamblen County Creamery Co., Morristown, Tenn., will erect a plant. Power equipment and refrigerating machinery will be needed. W. H. Mullins is Pres.

The Butler Creamery Co., Butler, Ky., is in the market for refrigerating equipment.

The S. F. McCormick Lumber Co., Lexington, Ky., will soon be in the market for motors for a new planing mill which it will erect.

CENTRAL STATES

Bonds for $120,000 have been voted for the construction of a municipal electric-light plant at Norwalk, Ohio.

The Springfield Street Ry. Co., Springfield, Ohio, will erect a new power plant. Power-plant equipment will be required.

Bids will be received until July 14 by the City Clerk, Tell City, Ind., for furnishing new power plant-equipment for the water-works. Robert M. Cass, 318 American Life Bldg., Indianapolis, is Consult. Engr.

WEST OF THE MISSISSIPPI

W. J. Squires, Leavenworth, Kan., contemplates constructing an electric-light plant at Leavenworth.

At a recent election, Powhattan, Kan., a bond issue of $10,000 for the construction of a municipal electric-light plant was voted.

Bids will be received by the city of Alexandria, S. D., about Aug. 1, for the construction of a municipal electric-light plant. H. M. Schumacher is city auditor.

Plans are being prepared by the De Leon-Gorman Light & Power Co., Gorman, Tex., for the construction of a power plant at Gorman.

The municipal electric-light plant, Taft, Tex., which was recently destroyed by fire, will be rebuilt.

The Sugar Pine Box Co., Riddle, Ore., plans to install an electric-light plant. Equipment will be needed. W. W. Vaughn, Riddle, is the Engr.-in-Charge.

F. D. Small and D. C. Urie, Tillamook, Ore., have been granted a franchise to construct and operate an electric-light plant at Tillamook. The estimated cost is $30,000.

The substation of the Pacific Gas & Electric Co., Oroville, Calif., was completely destroyed by fire June 19. Loss, $10.000.

The Central California Gas Co. will construct a purifier, boiler and compressor at Visalia, Calif., and will also make additions and other improvements to its plant.

CANADA

The city of Montreal, Que., will construct a municipal electric-light plant costing $172,667.

BUSINESS ITEMS

The Mesta Machine Co., Pittsburgh, Penn., has issued a new bulletin on Air Compressors and Vacuum Pumps—Bulletin N. It goes into complete details, contains a number of illustrations and should be of interest to every engineer. Copies are sent on request.

The Busch-Sulzer Bros.-Diesel Engine Co., St. Louis, Mo., has just closed a contract with the Lake Torpedo Boat Co. for six 600-b.hp. reversible two-cycle marine Diesel engines, whic hare to be installed on three twin-screw submarine torpedo boats now building for the U. S. Government.

The Nordberg Mfg. Co., Milwaukee, Wis., is now building Diesel engines, particularly of the largest sizes, having recently entered into an exclusive manufacturing arrangement with Usines Carels Freres, of Belgium, builders of the celebrated Carels engines.

An interesting book just published by the Smooth-On Manufacturing Co., Jersey City, N. J., is the new Smooth-On Instruction Book No. 7, devoted exclusively to the use of Smooth-On Iron Cement No. 7 for hardening, waterproofing, and oil proofing concrete. Copies will be mailed free on request.

TRADE CATALOGS

A. D. Granger Co., 90 West St., New York. Bulletin No. 2. "Oswego" internally fired water-tube boilers. Illustrated, 12 pp., 8x10 in.

Joseph T. Ryerson & Son, Chicago, Ill. Technical Library No. 4. Internal furnace boilers with Morison corrugated furnaces. Illustrated, 84 pp., 4½x7 in.

The Brown Hoisting Machinery Co., Cleveland, Ohio. Catalog S. Brownhoist suspended concrete bins. Illustrated, 40 pp., 6x9 in.

American Steam Gauge & Valve Mfg. Co., 208 Camden St., Boston, Mass. Catalog. "Thermofeed" regulator or controller. Illustrated, 40 pp., 5½x8½ in.

Chain Belt Co., Milwaukee, Wis. Catalog No. 54. "Chabelco" steel chain belt. Illustrated, 32 pp., 7x10 in.

Armstrong Cork & Insulation Co., Pittsburgh, Penn. Catalog. Nonpareil cork covering for cold pipes. Illustrated, 64 pp., 6x9 in.